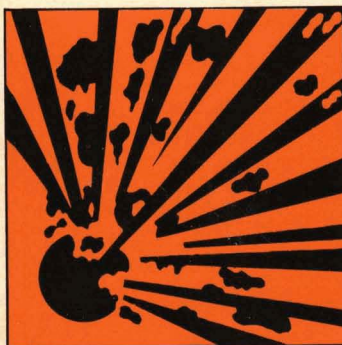


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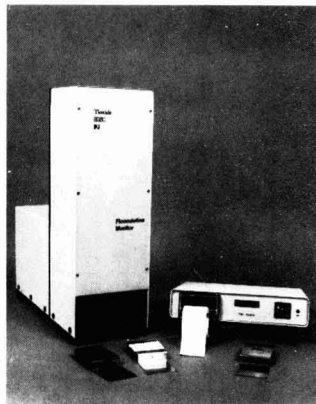
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OIL AND COLOUR CHEMISTS' ASSOCIATION

Priory House, 967 Harrow Road, Wembley, Middlesex, HA0 2SF England

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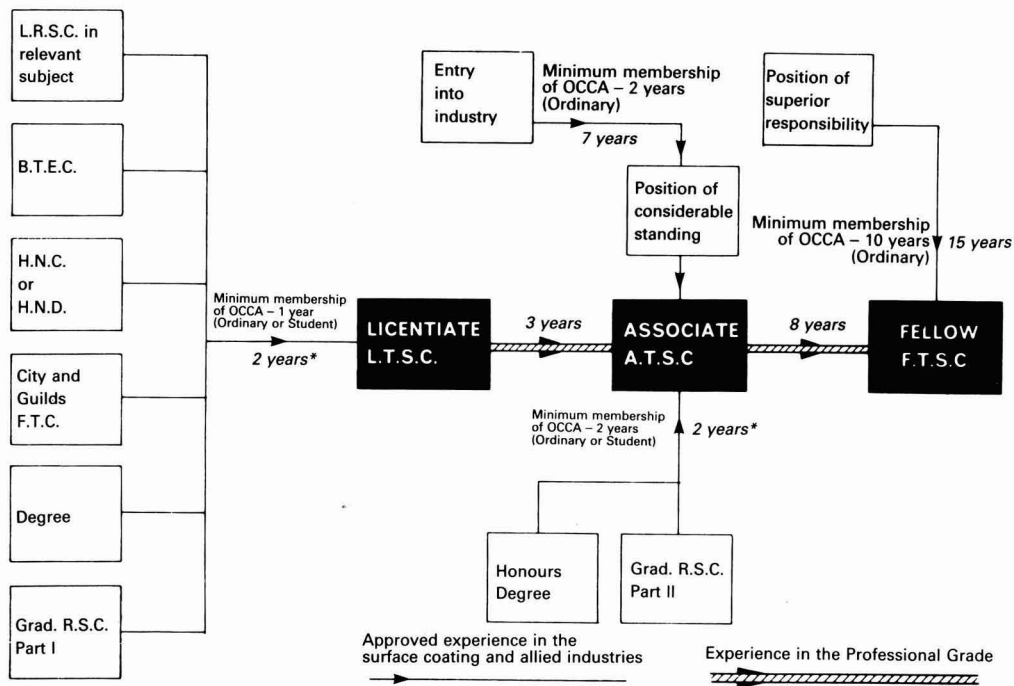
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Optional Professional Grade for Ordinary Members Routes to the Professional Grades

For the convenience of potential applicants, a chart indicating different routes to the various grades is shown below.



* 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.

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

A copy of the full regulations can be obtained from the Association's headquarters offices (Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, UK) by sending a stamped, addressed envelope with the words "Professional Grade Regulations" in the top left hand corner.

The full list of Ordinary Members admitted to the Professional Grade is published each year in the December issue of JOCCA and the candidate should refer to the list if necessary to find names of members in the Professional Grade who would be willing to sponsor their application. Those members resident overseas who do not know any members in the Professional Grade should write in the first instance to the Director & Secretary for advice. At present members resident in over 30 countries have been admitted to the Professional Grade.

Control of substances hazardous to health -draft regulations the implications for the painter*

M. J. Levete and W. E. G. Moffat

Paintmakers Association of Great Britain, Alembic House, 93 Albert Embankment, London SE1 7TY

Summary

All chemicals, whether or not they are known to have any hazardous properties should be handled in such a way to keep the exposure of people working with them as low as is reasonably practicable. How this aim will be achieved will differ according to each situation and depend upon a variety of factors. These will be discussed illustrating an assessment of the risks which should be carried out to ensure that appropriate control measures can be established to reduce the risks of exposure to acceptable levels. To demonstrate that such measures are effective, atmospheric monitoring of the workplace and monitoring the efficiency of equipment will need to be carried out periodically.

All chemicals, whether or not they are known to have any hazardous properties should be handled in such a way to keep the exposure of people working with them as low as is reasonably practicable. How this aim will be achieved will differ according to each situation and depend upon a variety of factors.

Regulations to control hazardous substances are, of course, not new for the paint industry. In 1907 there was the Paints and Colours Manufacture Regs., introduced to protect workers employed in handling lead compounds during "the manufacture of paints and colours or chromates of lead produced by boiling". Again in 1927 there was the Lead Paint Regulations aimed at protecting those employed in painting buildings with leaded paints. More recently in 1980 the Control of Lead at Work Regulations were published, with much the same intention as those of the 1907 Regulations but which were much more sophisticated in dealing with monitoring the working environment and employing medical surveillance techniques. Then again in 1967 the Carcinogenic Substances Regulations were introduced to protect workers from the hazards of carcinogens.

All of these have the common thread of health surveillance by appointed doctors which is now very much part of the draft Regulations being discussed. Some of these Regulations and many others will be revoked on the introduction of COSHH.

Justification for the measures in COSHH can be argued by the following examples of statistics:

1. In 1979/80 the Department of Health and Social Security awarded (in respect of diseases attributable to occupational exposure to substances¹) over 5,700 new injury benefits for short spells of incapacity, 850 new longer term disablement benefits, and 710 death benefits. Over the same period absence from work stemming from the new benefit cases of this type amounted to approximately 187,000 working days². These figures relate only to clearly established cases of those diseases for which benefit is payable and do not describe the full extent of the problem.

2. There are no statistics to show what proportion of chronic bronchitis, asthma and emphysema is occupationally linked. In 1980, there were over 20,000 deaths³ and over 30 million lost working days² from these causes.

3. Cancers (except mesothelioma and bladder cancer) are not covered by the DHSS statistics either. The proportion of cancer deaths which are occupationally related is a source of some controversy, but a recent review⁴ suggested that 2-8% of cancer deaths each year could be prevented if all occupational hazards were removed. Other sources have estimated up to 30% of disease is occupationally related⁵. There were 130,000 cancer deaths in Britain⁶ in 1980.

Those then are the reasons for the COSHH Regulations. The Health and Safety Commission decided rightly, or wrongly, that one set of Regulations to control all substances deemed to be hazardous to health was the correct way forward and not the piece-meal way as before. After all, it took four years to get the Control of Lead at Work Regulations of 1980 into force, and it could be argued that there are many thousands of substances which should be regulated in this way.

Clearly this approach would not be sensible if any real progress is to be achieved in the important area of worker protection.

The aims of the Regulations themselves as set down in the Consultative Document are:

- To consolidate existing requirements and to extend the number of substances covered and types of premises covered.
- To set out principles of occupational health which should be followed.
- To make provisions for any future changes in standards of controls necessary as a result of new hazards coming to light in respect of any particular substance.
- To comply with EEC Directive No. 80/1107/EC on the protection of workers from risks related to chemical, physical and biological agents at work.
- To ratify the ILO Convention No. 139 on carcinogenic substances and agents.
- To simplify and update existing legislation thereby making the law in relation to hazardous substances easier to comply with— and easier to enforce.

The implications for paint manufacturers from the proposals in the Consultative Document are considerable.

Assessment

The key to the Regulations as with the Control of Lead at Work Regulations 1980 mentioned previously is the carrying out of an assessment. An adequate assessment by a competent person is intended to identify the nature and degree of risk. This will then enable the employer, or self-employed person to determine the precautions needed to comply with the Regulations.

It will be an offence if an employer carries out work which may expose any employee to a hazardous substance unless he has made such an "adequate" assessment of the risks created by the substance to the health of the employee. Employees in some instances could also mean outside contractors working on site.

There has been a long debate about the use of the term "adequate" in this context but this will not be discussed here for obvious reasons. Such assessments will need to be undertaken by a person competent to do it. It will require a detailed investigation of all stages of a process from incoming raw materials to outgoing finished products. The following will need to be taken into consideration:

1. Total usage of the hazardous substances together with the maximum usage in any one day.
2. The form in which it is used or produced i.e. is it a dry powder, paste or liquid.
3. The identification of all areas of the plant, or process, where there is a risk of persons becoming exposed to it.
4. An assessment of the nature of the risks. This can come from how the substance is labelled, or from information from the supplier or from the experience of the employer in his work activity.

An example of the areas and the handling methods employed which will need to be identified and assessed are :

Raw material stores

- How is the substance unloaded and stacked?
- Where is it stored?
- How are damaged containers or bags dealt with?
- What happens to spillages and what decontamination processes are recommended?
- What is the general housekeeping standard?
- How is the substance weighed out and issued?

Laboratories

- How is the substance sampled, tested and evaluated?
- How are they handled during pilot scale manufacture?
- Quality control—special attention should be given here to spray application conditions and the sanding and flattening of coated panels.

Factory

- How is the substance transported throughout the factory?

- Specific attention should be given to those areas where any weighing and charging of the substance takes place, together with arrangements for storing partly full containers or bags, and disposing of empty sacks and containers.
- Removal of spillages and general housekeeping.
- Exhaust enclosures to control dust arising from opening, weighing, charging and disposing of empty sacks etc.
- Disposal of waste products.

Factory maintenance

This assessment should include an investigation into factory maintenance procedures e.g.

- An evaluation of the standards of maintenance.
- The integrity and effectiveness of dust collection systems from captive hoods or enclosures through to the final point of emission of air to the atmosphere.
- Procedures and frequency of maintenance and cleaning of extraction systems.
- Provision of protective clothing, respiratory protective equipment and systems of work for maintenance operations.

Protective equipment

Where this is provided the following will need to be assessed:

- Selection and suitability for its conditions of use.
- Methods of maintenance and storage of RPE as well as protective clothing.

These initial assessments are intended to enable an informed judgement to be made by the employer of the potential risk of exposure so that adequate management procedures can then be established to control the exposure. The assessment data and the action decided upon will need to be recorded in writing and retained. All in all this is another good example of Government imposing a policy on industry of self-regulation. Depending on the results of these assessments and to validate their conclusions, appropriate monitoring will need to be undertaken.

Everyone who is exposed to the hazardous substance will have been identified. This is where air monitoring may need to be brought in to provide reliable and relevant information to determine whether or not the occupational exposure limit for example is being achieved, and to identify those areas where improvements need to be made. Records of the monitoring that is undertaken will need to be retained for 30 years according to the proposals.

Control of exposure

Where from these assessments and monitoring exercises exposure levels are found to be inadequately controlled, measures will need to be taken to prevent the risk of damage to health of the employees. Safe systems of work will need to be set up and employees trained and instructed in them.

Obviously the measures to be taken to achieve this objective will depend on the results of the assessments. When there is the likelihood of high exposure it will be necessary to adopt more stringent precautions than in those cases where the risk is low. An example of this is where

only small quantities of a hazardous substance are used on an intermittent basis.

Some of the main risks to be guarded against are:

- Inhalation of solvent vapours, airborne dusts and particles.
- Contamination of the skin.

Personal protective equipment is the last line of defence where there is exposure to a hazardous substance. If after applying material, plant and process controls adequate control of exposure is not achieved, the regulations also require the provision of adequate and suitable personal protective equipment.

Methods of controlling exposure appropriate to the paint industry are:

- Elimination of the hazardous substance or substituting it in a safer form.
- Engineering controls.
- Personal protective equipment.
- Housekeeping—good working practices, routine plant maintenance.
- Good standards of employee hygiene.

Instruction and training

Instruction and provision of information

Employees who are likely to be exposed to a substance will need to be informed of:

- The nature of the risk to health created by such exposure.
- The precautions which have been taken as a result of the assessment.
- Information about the results of the monitoring in the work-place and the significance of the results.

Training

Appropriate training will need to be undertaken to enable all employees to carry out their duties without risk to themselves—or to others. They need to be trained in:

- Safe methods of work.
- The use of personal protective equipment.
- The importance of personal hygiene to reduce effects of exposure.
- Action to be carried out in an emergency.

Last but not least there is a requirement to provide adequate supervision to ensure that these measures are strictly adhered to.

Medical and health surveillance

It is not proposed to go into any detail on this part of the Regulations. Suffice to say that at the moment the Regulations will require an employer to arrange for each of his employees engaged on work that exposes him to a hazardous substance to be under appropriate health surveillance. In some instances this may require medical checks by an appointed doctor or employment medical advisor.

Health records of employees will need to be retained for at least 50 years showing among other things:

- Date of commencement of employment.
- Historical record of jobs while in employment.
- Appropriate details of likely exposure during that period.

The need for this is said to provide an ability to detect as early as possible any changes in health that could be attributable to exposure to a hazardous substance.

Problems in the paint manufacturing industry

All the way through this paper, reference has been made to exposure to a hazardous substance—not to hazardous substances. The Regulations as drafted are more appropriate to a dedicated plant using one or two substances. This is where the big problem will arise with these Regulations in the paint manufacturing industry.

The industry as is known uses, and produces, a wide range of substances and products, many of them complex mixtures in batch processes using non-dedicated plant. The scale and nature of the batch process does not permit automation. These are, therefore, largely manual operations which require relatively large numbers of process operators. Therefore, there is a constantly changing pattern of potential exposure.

For example a mill operator could charge and discharge four or five batches of different products all of different formulation using different hazardous substances in the course of one shift.

During discussions within the Association on how to comment on the Draft Regulations one example was given of a large Company which had a total inventory of about 8,000 raw materials, intermediates and finished goods all of which could be classified as hazardous under the definition. How then can the paint manufacturing industry cope with these draft Regulations?

The PA in its submission to the HSE emphasised the need for a tiered or priority approach to be adopted enabling resources to be applied in accordance with the degree of identified risk and not the potential hazard. Otherwise the Regulations would not be workable or enforceable. At the time of writing this document it is suspected that HSE has taken aboard this comment and that the final document will move away from the emphasis of hazard and more on to risk. Also the final Regulations may contain considerably less obligation for health surveillance. However, HSE has indicated that they did not intend to make any dramatic alterations where carcinogens are being handled—and rightly so.

As has been shown the implications for the paint industry arising from the COSHH Regulations are considerable, and already it is fairly obvious that in addition to the various Codes of Practice, Guidelines etc to be issued by the HSE, the paint industry will need its own version for paintmaking if it is to comply with COSHH.

[Received 10 April 1986

References over the page

References and notes

1. Excluding lead and asbestos, which are not covered by these proposals.
2. DHSS Social Security Statistics 1981, Government Statistical Services HMSO.
3. 1980 Mortality Statistics: Cause, OPCS Series DH 2 No. 7, HMSO.
4. "The Causes of Cancer" by Richard Doll and Richard Peto (*OUP*).
5. "Pilot Study Developments of an Occupational Disease Surveillance Method" Discher, Kleinman and Foster, University of Washington for US Department of Health, Education and Welfare 1975.
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Fire and explosion in the paint industry*

D. J. Reynolds

Berger Jenson and Nicholson Ltd, Freshwater Rd, Dagenham, Essex RM8 1RU.

Introduction

In 1785, a certain Count Morozzo delivered a paper to the Academy of Sciences of Turin on the subject of dust explosions together with some observations on spontaneous combustion. In his paper he made the following remarks:

"I shall not mention the inflammations caused by lightning, by subterranean fires and by other meteors; they are not of the nature of those of which I mean to speak, but I shall not pass over in silence the spontaneous combustions of human bodies. Though events of this kind are very rare, yet we have some examples of them recorded in the Philosophical Transactions and in the memoirs of the academies of Paris and of Copenhagen. It is there related that an Italian lady (the Countess Cornelia Bandi) was entirely reduced to ashes except her legs; that an English woman called Grace Pitt was almost entirely consumed by a spontaneous inflammation of her viscera; and lastly that a priest of Bergamo was consumed in the same manner. These spontaneous inflammations have been attributed to the abuse of spiritous liquors; but, though the victims of intemperance are very numerous, these certainly do not belong to that number.

The spontaneous inflammation of essential oils and that of some fat oils, when exposed with nitrous acid, are well known to philosophers; so also is that of powdered charcoal with the same acid; (lately discovered by M. Proust) and those of phosphorus, of pyrophorus and of fluminating gold. These substances are generally to be found only in the laboratories of chemists who are perfectly well acquainted with the precautions which it is necessary to take to prevent the unhappy accidents which may be occasioned by them".

He goes on to say:

"Ignorance of the fore-mentioned circumstances and a culpable negligence of those precautions which ought to be taken have often caused more misfortunes and loss than the most contriving malice; it is therefore of great importance that these facts should be universally known, that public utility may reap from them every possible advantage".

Nearly 200 years ago then the estimable Count said the most important things that need to be said about the use of hazardous substances. These are:

- To know the properties of the materials with which one is dealing.
- To take precautions appropriate to those risks.
- To make known the information so that other people can also take precautions.
- Ignorance and negligence are the things to guard against.

So far today the concern has been with the properties of materials which possess the potential for causing adverse health effects and it is right and proper that the subject should have received this amount of attention. However, it is also important that in the discussion a sense of balance and proportion is maintained and that we do not lose sight of other risks and the need to take precautions against them.

It is a sad fact that, Bhopal and Seveso apart, most major disasters affecting chemical plants that have occurred over the last 50 years have been fires and explosions. One has only to remember the Flixborough and Mexico City disasters to appreciate the loss of life and extensive property damage to which event of this kind can lead.

In the surface coatings industry, despite the growth of water based products, the nature and quantities of the flammable materials that are used and the types of processes that we employ mean that the risk of fire is an ever present one. In particular, the deliberate introduction of heat into certain processes, especially resin manufacture, requires that the risk is fully recognised and that proper precautions are taken. It should be remembered also that this risk is not confined to production areas as a significant number of fires have occurred in laboratories from the use of hot-plates, ovens etc.

The Paintmakers Association has been keeping its own records from returns by member companies for several years. These show that the number of fires over the last three years were:

- 1983 — 15 incidents
- 1984 — 25 incidents
- 1985 — 23 incidents

*Presented at the OCCA London Section Symposium, "Health and Safety in the Coatings and User Industries", 10 April, 1986

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No explosions were reported but there were four or five cases where bursting discs in resin reactors were blown as a result of exothermic reactions.

Fortunately, none of these was very serious but they serve to illustrate the size of the risk—a fire every 2½ weeks somewhere in the industry—and although they were minor in character it should be remembered that they all possessed the potential for far more serious effects. Most big fires start as small fires. The fact that big fires can also occur is illustrated by the fire at the Jotun paint factory in Norway just 10 years ago which resulted in the loss of six lives and an estimated property damage of £20 million. The cause of that fire was a spillage of flammable liquids which found a source of ignition in a nearby shrink-wrapping machine. Other less serious fires which still accounted for significant loss have also occurred since then.

Analysis of the 63 reported fires over the three year period shows the following causes:

| Cause | Number |
|------------------------|--------|
| Electrical | 20 |
| Static Electricity | 5 |
| Friction Heat | 6 |
| Spontaneous Ignition | 10 |
| Welding | 4 |
| Smoking Materials | 1 |
| Lagging Fires | 3 |
| Arson | 2 |
| Others/Not Established | 12 |
| Total | 63 |

In over half of the incidents the first material ignited was a flammable liquid.

This illustrates the size of the problem and indicates clearly the need for strong fire prevention programmes backed up by a fire fighting capability in all paint and resin factories. To deal with fire prevention first, that is the action that should be taken to prevent fires starting in the first place. What can be done?

Firstly, fires cannot occur if there is no fuel present (fire triangle) and, therefore, action should be taken to control the accumulation of flammable vapours in the air to below the lower explosive limit. Reverting to the earlier discussion, if airborne concentrations are controlled to occupational exposure limits they will by definition be well below flammable limits. Therefore, the first approach is the provision of good ventilation, especially local exhaust ventilation close to emission points, the use of enclosed systems where possible and the provision and use of covers for mobile containers and tanks containing flammable liquids.

Exclusion of ignition sources

Electrical

It is seen from the figures that the biggest single cause of fire is electrical faults of one kind or another. Flame-proof electrical equipment to an appropriate standard should be used wherever there is a risk of flammable vapours being present. Other electrical installations should be appropriate for the degree of hazard. But it is not enough to provide

and install adequate electrical systems—many of the fires reported arose because of lack of maintenance of what was originally perfectly satisfactory equipment. Regular and frequent inspection of electrical installations including wiring and junction boxes etc, is essential together with a prompt repair and maintenance capability. The accumulation of dust and resin/paint residues on flame-proof equipment acts as a very effective heat insulator and can downgrade the flame-proof standard.

Static electricity

Five of the reported fires were caused by static discharge. Static is potentially a very serious risk in our industry as high charges are so easily generated—by the movement of liquids and powders, by turbulence and by people themselves. In particular there is a high risk associated with insulating hydrocarbon solvents. Many of you will be aware of the outbreak of fires of this kind in association with pebble ball mills that occurred several years ago. Proper precautions must, therefore, be taken by:

- The provision of earthing and bonding arrangements at liquid transfer points.
- The restriction of pumping rates for solvents—a maximum of one metre per second.
- The restriction of the height of free fall liquids—a maximum of one metre.
- The avoidance of the use of insulating materials—some are obvious like plastic pipelines, others not quite so obvious e.g. the use of wooden pallet boards to carry tanks under high speed mixers.
- The removal of plastic shrink-wrapping etc, outside flammable liquid areas.
- The avoidance of people accumulating charges by the use of conductive overalls, e.g. avoid 100% synthetic materials—use instead cotton or cotton mixture, and the provision of anti-static footwear.
- The need for conductive floors and the prevention of insulating layers developing by the regular removal of paint and resin deposits.
- Regular, at least annual, conductivity tests to ensure adequate earthing of all fixed plant—a maximum resistance to earth of 10 ohms.

Friction heat

Most of the reported cases arose from inadequate maintenance of such things as belt drives and gears. Belts should be constructed of conductive material or regularly dressed to dissipate any charges.

Spontaneous combustion

The majority of reported cases arose from waste disposal especially of rags and wipers contaminated with paints and solvents. It is important that these should be disposed in metal bins with close fitting lids and damped with water. The bins should be removed from the premises at the end of the working day to a safe place. Security patrols should be instructed to check on these on a regular basis.

Welding

As has been stated, four fires were reported arising from welding activities. All of them were caused by contractors. This serves to illustrate the need to ensure that contractors are properly instructed on the hazards of any particular job and the precautions to be taken and the need for proper supervision of contractors activities. A written permit-to-work system should be employed whenever jobs of this kind which introduce abnormal hazards are undertaken. It should be remembered however, that a permit-to-work system has no value in itself and there is a danger of it degenerating into a paper work exercise. Its value lies in requiring people to assess fully what additional hazards are likely to be introduced by any operation and the provision of adequate safeguards and precautions.

Smoking

No-smoking rule should be observed and enforced in all manufacturing and storage areas. Smoking should only be permitted in approved locations supplied with large ashtrays preferably half-filled with sand.

Arson

Only two cases of arson were reported but it should be remembered that arson is now the biggest cause of all fires. There is only one answer to this and that is proper security.

Although no resin explosions were reported, as previously stated, a number of exotherms resulting in the blowing of bursting discs occurred. There is also a well documented history outside the period under review of major incidents in resin units. In addition, therefore, to the precautions discussed additional attention is required in resin making factories. As a minimum, reactors should be fitted with:

- Adequate pressure relief arrangements—experience shows that an adequately sized bursting disc together with a properly designed trunking leading to dump tanks to conduct discharges to a safe place is the best method.
- Adequate supplies of cooling water with visual/audible alarms to indicate the supply position.
- Safety instrumentation e.g. high temperature alarms to give early warnings of any departure from the expected cooking schedule.

The three lagging fires that were reported also occurred in resin units. This type of fire has been a common feature of resin activities and precautions must be taken to prevent lagging becoming impregnated with flammable materials.

In addition to the specific precautions listed there are well established and proven fire prevention methods that should be adopted:

- *Housekeeping*—High standards of industrial housekeeping are the cornerstone of a successful fire prevention programme, as indeed they are for the health care and safety programmes. In housekeeping I include minor maintenance—attention to leaking glands, pumps etc.

- *Fire Compartmentation by separation and segregation of*

storage and process areas—The provision of adequate fire separation distances and fire break/radiation walls, and the importance of maintaining their integrity—by all means make holes to allow the passage of pipework or electrical trunking but make sure they are completely fire-stopped afterwards.

One sees only too often the spaces between buildings which were designed to be fire separation distances used as storage area for barrels and pallet boards, or barrels and pallet boards stacked tightly against building walls. This means that the design safeguards are nullified thus increasing the risk of fire spread and putting the whole site at risk instead of confining it to a particular area. Designated storage areas should be clearly delineated and adequate separation distances maintained.

- *Fire Doors*—These are also necessary to ensure that effective fire compartmentation is achieved. Yet again these are also often inoperable because of materials stacked tightly against them which prevents their operation or because they are deliberately wedged open. A major fire in one paint manufacturing company was able to spread in this way and what should have been a contained fire spread and enveloped the entire premises. There should be a regular shut-down procedure at the end of the working day to ensure that all fire doors are in the closed position.

- *Means of escape*—Escape routes should be clearly and prominently marked and kept free of obstruction.

- *Training*—All employees should be instructed and regularly practiced in the action to be taken in the event of a fire.

Despite all the precautions that are taken, however, the risk of fire cannot be totally eliminated. It is important therefore, to have a fire fighting capability. In addition to the provision of fire fighting equipment such as hose reels and extinguishers the essential elements of a successful fire fighting programme are:

- Early detection.
- A quick first hit capability.

Many fires, particularly warehouse fires, occur outside normal working hours. Automatic detection is therefore the preferred option. Sprinkler systems satisfy both criteria as they give both automatic detection and a first hit. Other systems such as smoke/heat detectors, Halon flooding etc, may also be appropriate in some circumstances. Fires involving paint materials invariably produce heavy dense black smoke which makes fire fighting difficult. The provision of smoke vents is also desirable.

In larger companies the establishment of a works fire brigade which is well instructed and which trains regularly is also a prudent precaution.

In conclusion, mention must be made of the statutory framework covering the storage and use of flammable liquids.

There are two principal legal instruments:

- The Petroleum (Consolidation Act 1928) with its

licensing conditions etc, which applies to the keeping of petroleum based products with a flash point below 73°F.

● The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972 which extended statutory controls to other flammable liquids with a flash point below 32°C.

This statutory framework is not particularly relevant today:

● The Petroleum Act is now nearly 60 years old, large section of it have been revoked and it is badly in need of being brought up to date.

● The HFL Regulations have proved to be inadequately drafted in a number of ways and have presented problems of interpretation and standard enforcement.

● The legislation is enforced by two different authorities—the Petroleum Act by Local Authorities and the HFL Regs by Factory Inspectors. This again has resulted in different standards of enforcement both between the agencies themselves and between different parts of the country.

● The distinction between petroleum products and other

flammable liquids has become increasingly meaningless in the industrial context.

It is understood that HSE intends to introduce new flammable liquid regulations some time in 1986. The final form that the Regulations will take is not known but present indications are that a single set of Regulations couched in general terms and supplemented by Codes of Practice and Guidance Notes will be made covering the use of all flammable liquids. One thing that is known is that the classification of flammable liquids will be brought into line with EEC standards, that is to say liquids with a flash point below 21°C will be classified as highly flammable and those with a flash point between 21°C and 55°C as flammable liquids. Another important change will be that any liquid stored or processed at or above its flash point will be regarded as highly flammable.

Time will tell what other areas the proposed Regulations will cover. However, whatever their final shape, enough has been said to highlight the importance of companies identifying their risks, assessing the nature and degree of the risks and ensuring that proper precautions and safeguards are taken to protect both human life and the business.

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The influence of associative thickeners on coatings performance: III. Variation in percent non-volatiles

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Abstract

In previous studies, the influence of hydrophobically-modified, water-soluble polymers ("associative thickeners") has been examined with small-particle-size, all-acrylic and heterodispersed, HEC-stabilized, vinyl acetate/acrylate latices. These studies were conducted in 32 per cent non-volatiles by volume (%NVV) formulations in which the pigment volume concentration (PVC) was varied, and the weight per cent of thickener employed was based on the total weight of the formulation. In this investigation the %NVV is varied concomitant with PVC. Variations, and thickener concentrations are based on a normalized aqueous concentration to provide data for mechanistic interpretations of rheological differences. Distinct differences in high (ϵ_h) and low (ϵ_l) shear viscosity efficiency parameters among thickeners are observed in both all-acrylic and the HEC-stabilized vinyl/acrylate formulations. With both latices all thickened formulations follow two common trends: 1. The aqueous concentration efficiency parameters increase as the %NVV increases and in 22 and 32% NVV coatings the efficiency parameters are relatively insensitive to variation in PVC. 2. In 42% NVV coatings the efficiency parameters are sensitive to variations in PVC, but are different in their responses. The viscosity efficiency parameters are highest in formulations containing the small all-acrylic latex at 25 PVC, and in contrast, are highest at 57 PVC in the HEC-stabilized vinyl/acrylate latex. The data are interpretable in terms of the DLVO theory. In the crowded formulations (volume fraction = .42) containing the small-particle all-acrylic, surfactant-stabilized latex, the latex flocculates; in the larger, heterodispersed and osmotically stabilized vinyl/acrylate latex formulation, the TiO_2 flocculates. The slope of the efficiency parameters with %NVV variation at any PVC appears to suggest that certain of the thickeners are associating with the small-particle acrylic latex. A true delineation of such a mechanism awaits analysis of 22% NVV coatings devoid of the larger extender pigments. There are notable exceptions in the study that indicate some of the thickeners preferentially interact with pigments. Comparison of ϵ_h among thickeners indicates that HEUR 200 thickened formulations are relatively insensitive to both %NVV and PVC variation. The ϵ_h values for HEUR 708 formulations at 22% NVV are higher than those observed with other formulations; this difference is maintained as the %NVV is increased. HEUR 100 exhibits the strongest dependence on %NVV changes in 25 PVC formulations.

Introduction

In previous studies, interior coating formulations containing a small-particle-size, all-acrylic latex¹ and a larger-particle-size heterodispersed vinyl acetate/acrylate latex², with hydroxyethyl cellulose chemically attached to the latex's surface for additional stability, were examined employing hydroxyethyl cellulose (HEC) and a series of hydrophobically modified water-soluble polymers as formulation thickeners. In these studies, reported in Parts I and II of this series, the amount of thickener was varied to obtain formulations with Stormer viscosities of 80, 90, 105 and 120 KU and the amount of extender pigment was reduced to vary the PVC (57, 45, 35 and 25 intervals) of the formulations. The total per cent non-volatiles by volume (%NVV) of these coatings was constant (32%). In this study the amount of thickener and PVC are varied as before but concomitant with these changes the %NVV is

varied (22 and 42% in addition to the standard 32% NVV level).

Experimental

The techniques and formulation components employed are similar to those described in Parts I and II. The emphasis of this investigation is in delineating thickener influences (at concentrations required to achieve 80, 90, 105 and 120 KU) at higher (42) and lower (22) %NVV in formulations of 57, 45, 35 and 25 PVC. The %NVV changes are achieved by controlling the amount of water used in the formulation. A hydrophobically-modified HEC³ (H-M, HEC) supplied by Hercules Inc (WSP D-80) was also included in this study. The amounts of thickener required to achieve a given KU in the variable PVC, %NVV formulations are given in Tables 1 and 2. Two of the HEUR thickeners, L-75 and LR-8500, examined in the previous studies^{1, 2}, were not included in these investigations due to lack of availability.

Results and discussion

High shear viscosities (HSVs)

57 PVC Formulations

Small-particle-size, surfactant-stabilized all-acrylic latex formulations:

The general rheological profiles of the formulations studied at 32% NVV are illustrated in Figures 3 and 4 of Part I¹. The high shear viscosity analysis as a function of thickener wt.% at this %NVV level was illustrated in Figure 7. The latter data should be compared with equivalent studies at 22% NVV (Figure 1) and 42% NVV (Figure 2). A cursory examination demonstrates that all thickeners studied are sensitive to %NVV variation. As the %NVV level is increased, the amount of thickener required to achieve a given KU level decreases and the HSV increases as a function of the weight per cent employed. In comparison with other thickeners, HEUR-100 exhibits the most dramatic %NVV dependence. It is relatively ineffective at 22% NVV (Figure 1); becomes comparable to HEUR-200 and HEC (both of which are much higher in molecular weight¹) at 32% NVV (Figure 7 in Part I) and approaches the performance of HEUR-708 and SMAT at 42% NVV (Figure 2). The HSV of HEUR-200 formulations is not significantly better than HEC thickened formulations at any %NVV level. As the %NVV is decreased, the effectiveness of SMAT formulations decreases slightly relative to HEUR-708 formulations.

HEC-stabilized, vinyl acetate/acrylate latex formulations:

Comparable 57 PVC formulations containing larger and heterodispersed vinyl acetate/acrylate latices (at 22 and 42 %NVV) were investigated (HSV data, Figures 3 and 4). The data should be compared with the 32% NVV coatings (Part II of this series², Figure 5). Deviations from the trends

Table 1

Thickener amounts and Stormer viscosities (KU) obtained in small-particle, all-acrylic formulations

| 22% NVV; 25 PVC | | | | | | | | | 42% NVV; 25 PVC | | | | | | | | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|-----------------|------------|------|----|------|-----|------|-----|------|-----------|----|------|----|------|-----|------|
| Desired KU | | 80 | | 90 | | 105 | | 120 | | Desired KU | | 80 | | 90 | | 105 | | 120 | | | | | | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | | |
| HEUR 100 | 77 | 1.24 | 90 | 1.54 | 104 | 1.84 | 121 | 2.54 | HEUR 100 | 79 | 0.06 | 91 | 0.09 | 103 | 0.13 | 117 | 0.19 | HEUR 100 | 79 | 0.06 | 91 | 0.09 | 103 | 0.13 |
| HEUR 200 | 86 | 1.32 | 96 | 1.49 | 108 | 1.75 | 124 | 2.03 | HEUR 200 | 79 | 0.23 | 87 | 0.28 | 103 | 0.48 | 122 | 0.68 | HEUR 200 | 79 | 0.23 | 87 | 0.28 | 103 | 0.48 |
| HEUR 708 | 86 | 0.69 | 94 | 0.91 | 109 | 1.14 | 123 | 1.41 | HEUR 708 | 85 | 0.05 | 90 | 0.07 | 106 | 0.11 | 120 | 0.18 | HEUR 708 | 85 | 0.05 | 90 | 0.07 | 106 | 0.11 |
| HEC:MHR | 82 | 0.58 | 95 | 0.71 | 106 | 0.90 | 121 | 1.11 | HEC:MHR | 80 | 0.10 | 89 | 0.14 | 97 | 0.18 | 105 | 0.22 | HEC:MHR | 80 | 0.10 | 89 | 0.14 | 97 | 0.18 |

| 22% NVV; 35 PVC | | | | | | | | | 42% NVV; 35 PVC | | | | | | | | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|-----------------|------------|------|----|------|-----|------|-----|------|-----------|----|------|----|------|-----|------|
| Desired KU | | 80 | | 90 | | 105 | | 120 | | Desired KU | | 80 | | 90 | | 105 | | 120 | | | | | | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | | |
| HEUR 100 | 64 | 1.07 | 86 | 1.74 | 102 | 2.28 | 116 | 2.68 | HEUR 100 | 83 | 0.09 | 93 | 0.17 | 108 | 0.27 | 124 | 0.39 | HEUR 100 | 83 | 0.09 | 93 | 0.17 | 108 | 0.27 |
| HEUR 200 | 80 | 1.13 | 89 | 1.29 | 104 | 1.59 | 121 | 1.94 | HEUR 200 | 81 | 0.30 | 90 | 0.41 | 102 | 0.54 | 116 | 0.76 | HEUR 200 | 81 | 0.30 | 90 | 0.41 | 102 | 0.54 |
| HEUR 708 | 80 | 0.76 | 88 | 0.88 | 103 | 1.11 | 119 | 1.42 | HEUR 708 | — | — | 95 | 0.15 | 108 | 0.21 | 124 | 0.28 | HEUR 708 | — | — | 95 | 0.15 | 108 | 0.21 |
| HM-HEC | 77 | 0.65 | 87 | 0.75 | 100 | 0.86 | 110 | 0.99 | HM-HEC | 83 | 0.17 | 90 | 0.19 | 103 | 0.26 | 114 | 0.33 | HM-HEC | 83 | 0.17 | 90 | 0.19 | 103 | 0.26 |
| HEC:MHR | 82 | 0.60 | 90 | 0.68 | 100 | 0.81 | 115 | 1.00 | HEC:MHR | 82 | 0.15 | 90 | 0.18 | 104 | 0.26 | 115 | 0.33 | HEC:MHR | 82 | 0.15 | 90 | 0.18 | 104 | 0.26 |

| 22% NVV; 45 PVC | | | | | | | | | 42% NVV; 45 PVC | | | | | | | | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|-----------------|------------|------|----|------|-----|------|-----|------|-----------|----|------|----|------|-----|------|
| Desired KU | | 80 | | 90 | | 105 | | 120 | | Desired KU | | 80 | | 90 | | 105 | | 120 | | | | | | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | | |
| HEUR 200 | 79 | 1.04 | 90 | 1.25 | 105 | 1.50 | 121 | 1.70 | HEUR 200 | 79 | 0.42 | 89 | 0.54 | 104 | 0.75 | 120 | 0.99 | HEUR 200 | 79 | 0.42 | 89 | 0.54 | 104 | 0.75 |
| HEUR 708 | 80 | 0.61 | 89 | 0.70 | 105 | 0.89 | 121 | 1.15 | HEUR 708 | — | — | 94 | 0.18 | 102 | 0.25 | 121 | 0.37 | HEUR 708 | — | — | 94 | 0.18 | 102 | 0.25 |
| HM-HEC | 81 | 0.55 | 89 | 0.61 | 99 | 0.73 | 112 | 0.86 | HM-HEC | 82 | 0.21 | 92 | 0.26 | 102 | 0.32 | 120 | 0.44 | HM-HEC | 82 | 0.21 | 92 | 0.26 | 102 | 0.32 |
| HEC:MHR | 83 | 0.52 | 92 | 0.58 | 104 | 0.76 | 120 | 0.93 | HEC:MHR | 84 | 0.18 | 94 | 0.26 | 105 | 0.32 | 122 | 0.46 | HEC:MHR | 84 | 0.18 | 94 | 0.26 | 105 | 0.32 |

| 22% NVV; 57 PVC | | | | | | | | | 42% NVV; 57 PVC | | | | | | | | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|-----------------|------------|------|----|------|-----|------|-----|------|-----------|----|------|----|------|-----|------|
| Desired KU | | 80 | | 90 | | 105 | | 120 | | Desired KU | | 80 | | 90 | | 105 | | 120 | | | | | | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% | Thickener | KU | Wt.% | KU | Wt.% | | |
| HEUR 100 | 79 | 1.43 | 88 | 1.66 | 104 | 2.02 | 117 | 2.33 | HEUR 100 | 84 | 0.12 | 95 | 0.18 | 108 | 0.29 | 121 | 0.44 | HEUR 100 | 84 | 0.12 | 95 | 0.18 | 108 | 0.29 |
| HEUR 200 | 84 | 0.97 | 90 | 1.04 | 102 | 1.21 | 122 | 1.50 | HEUR 200 | 82 | 0.39 | 98 | 0.55 | 108 | 0.66 | 121 | 0.75 | HEUR 200 | 82 | 0.39 | 98 | 0.55 | 108 | 0.66 |
| HEUR 708 | 80 | 0.79 | 89 | 0.90 | 104 | 1.10 | 116 | 1.24 | HEUR 708 | 83 | 0.16 | 93 | 0.22 | — | — | 120 | 0.39 | HEUR 708 | 83 | 0.16 | 93 | 0.22 | — | — |
| SMAT | 79 | 0.82 | 90 | 1.02 | 104 | 1.23 | 117 | 1.46 | SMAT | 82 | 0.19 | 97 | 0.28 | 109 | 0.35 | 125 | 0.44 | SMAT | 82 | 0.19 | 97 | 0.28 | 109 | 0.35 |
| HM-HEC | 78 | 0.59 | 89 | 0.74 | 100 | 0.81 | 116 | 1.00 | HM-HEC | 84 | 0.20 | 94 | 0.24 | 105 | 0.29 | 116 | 0.35 | HM-HEC | 84 | 0.20 | 94 | 0.24 | 105 | 0.29 |
| HEC:MHR | — | — | 90 | 0.63 | 102 | 0.78 | 120 | 1.01 | HEC:MHR | 85 | 0.18 | 94 | 0.22 | 108 | 0.35 | 123 | 0.41 | HEC:MHR | 85 | 0.18 | 94 | 0.22 | 108 | 0.35 |

observed in the all-acrylic, surfactant stabilized latex formulations are apparent. The HSVs of HEC and HEUR 200 are high in the formulations containing the vinyl acetate/acrylate latex. There is a noted decrease in the efficiency of SMAT and HEUR 100 at both the 22 and 42% NVV levels (Figures 3 and 4).

35 PVC formulations:

As the PVC is lowered by removing calcium carbonate and silicates (extender pigments) in the small-particle all-acrylic latex formulations, greater differentiation among thickeners at 42% NVV is evident (compare Figure 6 with Figure 2). There is generally less differentiation among thickeners at 22% NVV (Figure 5). The HSVs of the hydrophobe-modified HEC-thickened formulations are not significantly different from the non-modified HEC-thickened coatings. All of the thickeners are much less efficient in the less crowded system.

When the latex is the vinyl acetate/acrylate binder (Figures 7 and 8) there are greater parallels in HSV efficiency between the lower and the higher PVC formulations. HEUR 100 and SMAT are less effective with the HEC stabilized binder than with the small particle, surfactant stabilized all-acrylic latex. The most notable difference with a decrease in the PVC, is the loss in HSV efficiency of HEC and HEUR 200 formulations.

Low shear viscosities (LSVs)

The low shear viscosities (LSVs) of 57 PVC formulations containing the small-particle, all-acrylic latex, are illustrated in Figures 9 and 10. The data should be compared with the 32% NVV study (Figure 10 in Part I). Corresponding data at 35 PVC are presented in Figures 11 and 12, which should be compared with Figure 11 in Part I. In general, there are no unexpected deviations; the hydrophobically-modified, HEUR type water-soluble

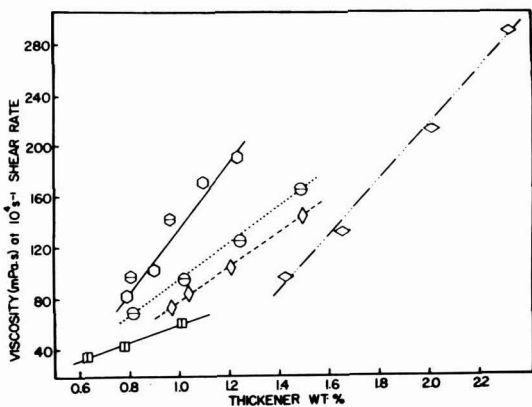


Figure 1. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/57 PVC, small-particle, all-acrylic latex formulations. Water-soluble thickeners: \square HEC:MHR; \blacktriangle HM-HEC; \circ SMAT. The following are HEUR type: \square 708; \diamond 200; \triangleleft 100. (Horizontally crossed symbols represent different pigment grind).

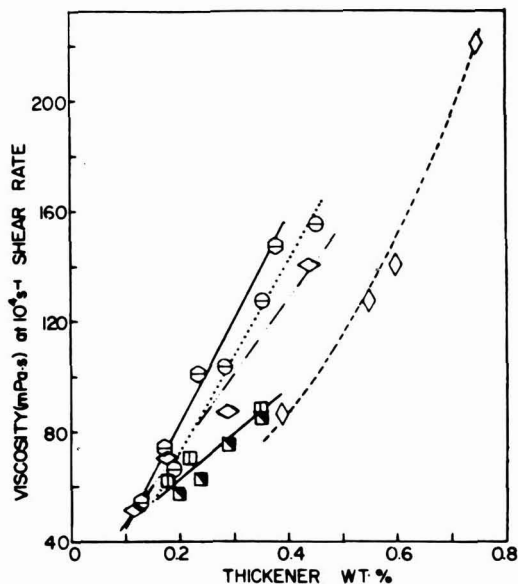


Figure 2. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/57 PVC, small-particle, all-acrylic latex formulations. (Horizontally crossed symbols represent different pigment grind)*.

polymers have lower low shear viscosities (in most cases too low, as reflected by sag values in Table 3, especially in the low %NVV formulations). The LSVs are sensitive to variations in %NVV, but relatively insensitive to changes in PVC in the small-particle, all-acrylic formulations. The formulations containing HEUR 200 are particularly sensitive to %NVV variations.

The most interesting variation observed in these studies is the influence of hydrophobe modification of hydroxyethyl cellulose³. The hydrophobe segments are probably attached to the ends⁴ of the longest oxyethylene

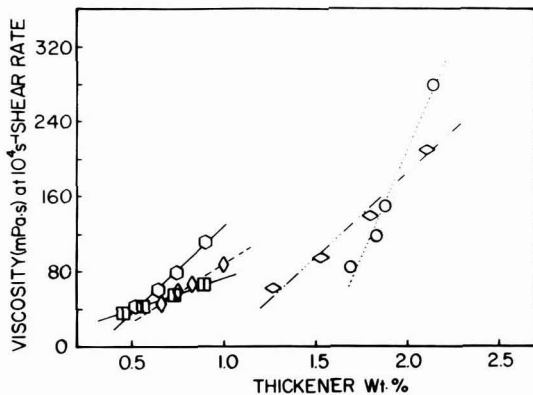


Figure 3. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

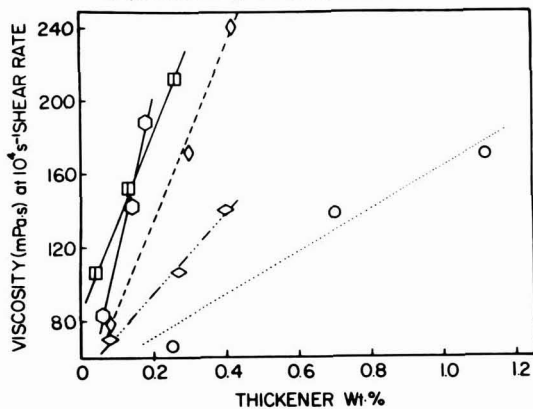


Figure 4. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

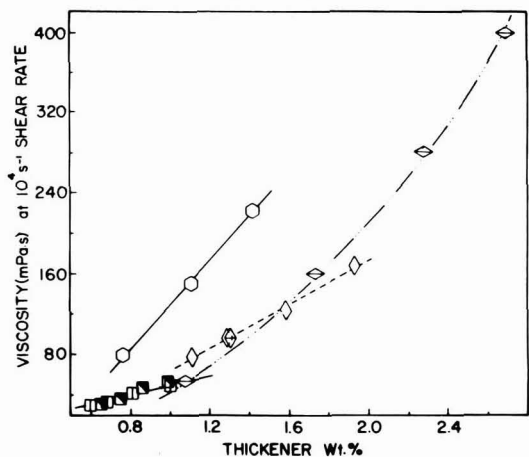


Figure 5. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/35 PVC, small-particle, all-acrylic latex formulations. (Horizontally crossed symbols represent different pigment grind)*.

Table 2

Thickener amounts and Stormer viscosities (KU) obtained in HEC-stabilized, vinyl acetate/acrylate formulations

| 22% NVV; 35 PVC | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|
| Desired KU | 80 | | 90 | | 105 | | 120 | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% |
| HEUR 100 | 82 | 1.65 | 95 | 1.88 | 102 | 2.11 | 116 | 2.34 |
| HEUR 200 | 86 | 1.05 | 98 | 1.10 | 108 | 1.24 | 122 | 1.41 |
| HEUR 708 | 86 | 0.70 | 95 | 0.81 | 104 | 0.97 | 120 | 1.12 |
| SMAT | 78 | 1.42 | 98 | 1.79 | 104 | 2.06 | 118 | 2.47 |
| HEC:MHR | 72 | 0.72 | 82 | 0.80 | 89 | 0.88 | 97 | 0.97 |

| 22% NVV; 57 PVC | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|
| Desired KU | 80 | | 90 | | 105 | | 120 | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% |
| HEUR 100 | 80 | 1.27 | 91 | 1.53 | 105 | 1.53 | 120 | 2.11 |
| HEUR 200 | 81 | 0.66 | 94 | 0.75 | 105 | 0.83 | 122 | 1.00 |
| HEUR 708 | 82 | 0.52 | 95 | 0.64 | 106 | 0.74 | 121 | 0.90 |
| SMAT | 81 | 1.69 | 96 | 1.83 | 106 | 1.88 | 136 | 2.14 |
| HEC:MHR | 81 | 0.45 | 92 | 0.56 | 107 | 0.73 | 122 | 0.88 |

| 42% NVV; 35 PVC | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|
| Desired KU | 80 | | 90 | | 105 | | 120 | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% |
| HEUR 100 | 82 | 0.38 | 92 | 0.44 | 102 | 0.59 | 118 | 0.81 |
| HEUR 200 | 77 | 0.31 | 94 | 0.59 | 104 | 0.69 | 119 | 0.84 |
| HEUR 708 | 82 | 0.23 | 95 | 0.25 | 106 | 0.34 | 125 | 0.42 |
| SMAT | 84 | 0.50 | 98 | 0.70 | 120 | 0.82 | 128 | 1.03 |
| HEC:MHR | 72 | 0.14 | 86 | 0.23 | 88 | 0.24 | 95 | 0.30 |

| 42% NVV; 57 PVC | | | | | | | | |
|-----------------|----|------|----|------|-----|------|-----|------|
| Desired KU | 80 | | 90 | | 105 | | 120 | |
| Thickener | KU | Wt.% | KU | Wt.% | KU | Wt.% | KU | Wt.% |
| HEUR 100 | — | — | 91 | 0.08 | 104 | 0.27 | 119 | 0.40 |
| HEUR 200 | — | — | 90 | 0.08 | 104 | 0.30 | 120 | 0.42 |
| HEUR 708 | — | — | 91 | 0.06 | 106 | 0.14 | 120 | 0.70 |
| SMAT | 78 | 0.25 | — | — | — | — | 120 | 0.70 |
| HEC:MHR | — | — | 91 | 0.06 | 106 | 0.14 | 120 | 0.18 |

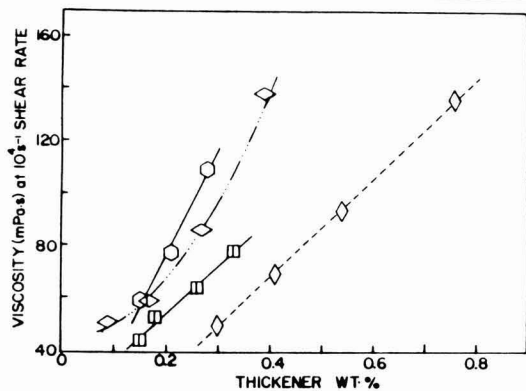


Figure 6. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/35 PVC, small-particle, all-acrylic latex formulations*.

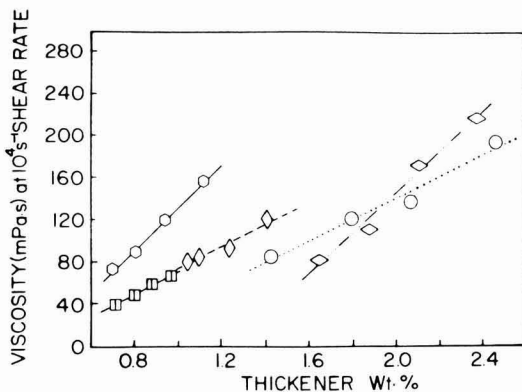


Figure 7. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/35 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

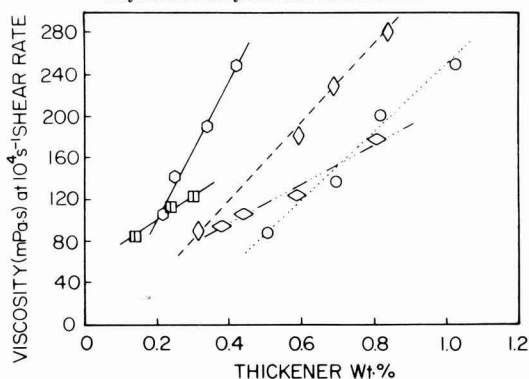


Figure 8. High-shear-rate (10^4 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/35 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

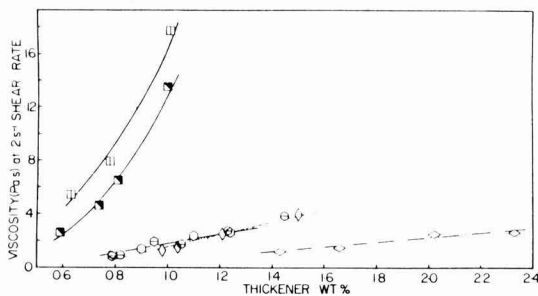


Figure 9. Low-shear-rate (2 s^{-1}) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/57 PVC, small-particle, all acrylic latex formulations. (Horizontally cross symbols represent different pigment grind)*.

segments of hydroxyethyl cellulose. The oxyethylene chains have an average⁵ of four oxyethylene units, with a very low percentage approaching an average length of 10. The number of oxyethylene units between the hydrophobe and the cellulose main chain is relatively small. Despite this small difference with HEC considerably lower LSVs are observed in H-M, HEC thickened formulations (Figures 9

* The thickener symbols are as defined in Figure 1.

Table 3

Sag data for small-particle, all-acrylic formulations

| %NVV 22 | | | | | | | | | | | | | | | | |
|-----------|----|----|-----|-----|----|----|-----|-----|----|----|-----|-----|----|----|-----|-----|
| PVC | 25 | | | | 35 | | | | 45 | | | | 57 | | | |
| KU | 80 | 90 | 105 | 120 | 80 | 90 | 105 | 120 | 80 | 90 | 105 | 120 | 80 | 90 | 105 | 120 |
| Thickener | | | | | | | | | | | | | | | | |
| HEUR 100 | 4 | 6 | 7 | 9 | — | — | — | — | — | — | — | — | 5 | 6 | 6 | 7 |
| HEUR 200 | 7 | 8 | 8 | 9 | 4 | 7 | 7 | 8 | 5 | 6 | 7 | 8 | 5 | 5 | 6 | 8 |
| HEUR 708 | 4 | 7 | 7 | 8 | 4 | 4 | 5 | 6 | 4 | 4 | 6 | 7 | 4 | 5 | 6 | 7 |
| HEC:MHR | 14 | 14 | 20 | 30 | 11 | 12 | 14 | 16 | 11 | 12 | 14 | 16 | — | 11 | 14 | 18 |

| %NVV 42 | | | | | | | | | | | | | | | | |
|-----------|----|----|-----|-----|----|----|-----|-----|----|----|-----|-----|----|----|-----|-----|
| PVC | 25 | | | | 35 | | | | 45 | | | | 57 | | | |
| KU | 80 | 90 | 105 | 120 | 80 | 90 | 105 | 120 | 80 | 90 | 105 | 120 | 80 | 90 | 105 | 120 |
| Thickener | | | | | | | | | | | | | | | | |
| HEUR 100 | 9 | 11 | 12 | 14 | 8 | 11 | 12 | 14 | — | — | — | — | 6 | 7 | 10 | 12 |
| HEUR 200 | 25 | 35 | >60 | >60 | 20 | 30 | 50 | >60 | 20 | 25 | 50 | >60 | 20 | 25 | 35 | 50 |
| HEUR 708 | 10 | 12 | 16 | 18 | — | 12 | 16 | 18 | 10 | 11 | 12 | 14 | 8 | 12 | 14 | 18 |
| HEC:MHR | 16 | 18 | 18 | 25 | 16 | 18 | 20 | 25 | 16 | 20 | 25 | 30 | 14 | 16 | 25 | 35 |

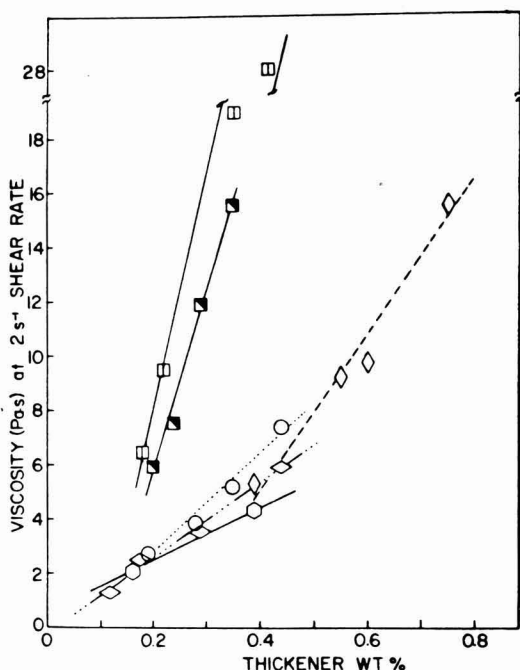


Figure 10. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/57 PVC, small-particle, all-acrylic latex formulations*.

and 11). In contrast to the HEUR type thickeners, the LSVs of H-M, HEC exhibit greater sensitivity to PVC variations than to changes in the %NVV level. Difference in HSVs of H-M, HEC thickened formulations were not observed in the small-particle, all-acrylic latex study.

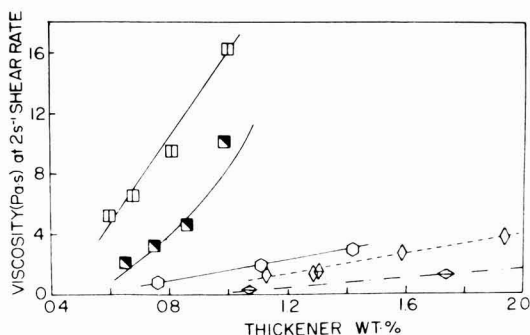


Figure 11. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/35 PVC, small-particle, all-acrylic latex formulations*.

The low shear viscosities of the formulations containing the HEC-stabilized, vinyl acetate/acrylate binder are illustrated in Figures 13-16. It was necessary to use a different latex production sample relative to the one used in Part II of this series, in the preparation of 35/22 and 35/42 (PVC/%NVV) coatings. In general the data parallel previous 32 %NVV data; LSVs are higher than those of corresponding formulations containing the small-particle, all-acrylic binder. SMAT is very ineffective with the HEC-stabilized, vinyl acetate/acrylate latex, and very low LSVs are observed irrespective of the %NVV or PVC. The LSVs of HEUR 100 formulations exhibit a greater sensitivity to %NVV levels than to variations in the PVC; HEUR 200 exhibits greater LSV sensitivity to PVC variations. The LSVs or HEUR 708 formulations are approximate to those of HEC formulations in the 42% NVV formulations.

Complexities in %NVV analysis

The amounts of water-soluble polymer required to thicken

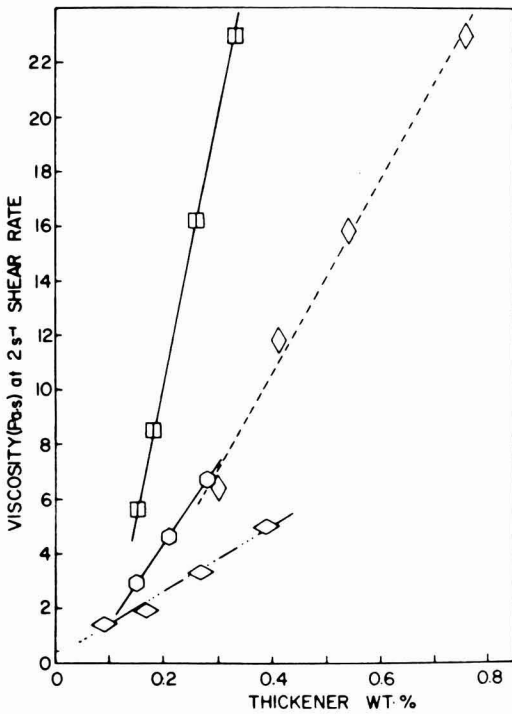


Figure 12. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/35 PVC, small-particle, all-acrylic latex formulations. (Horizontally crossed symbols represent different pigment grind)*.

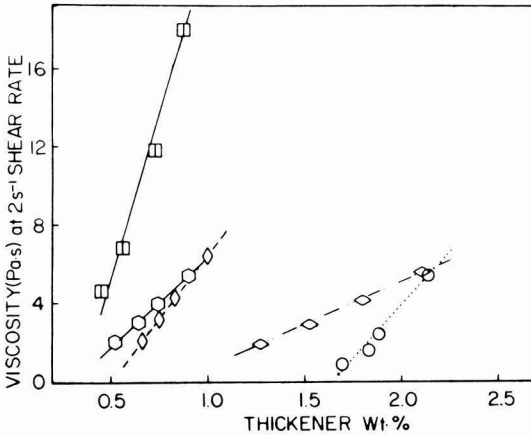


Figure 13. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

a formulation to a given KU (Tables 1 and 2) results in different HSV dependencies (Figures 1 - 8). To obtain a comparison of thickening efficiencies among different %NVV formulations, a modified HSV weight per cent, w_h , is selected (illustrated in Figure 17). This is the weight per cent of water-soluble polymer required to thicken a formulation to 100 mPa.s above its non-thickened viscosity level at $10^4 s^{-1}$ shear rate. Non-thickened formulation

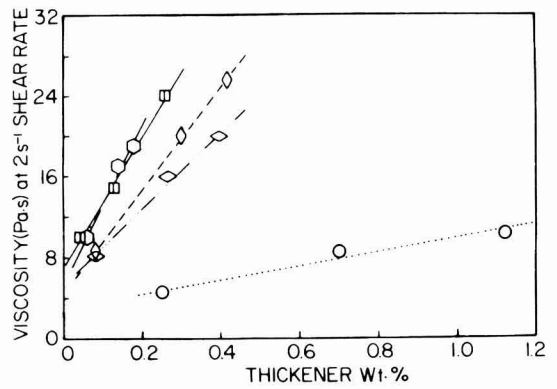


Figure 14. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

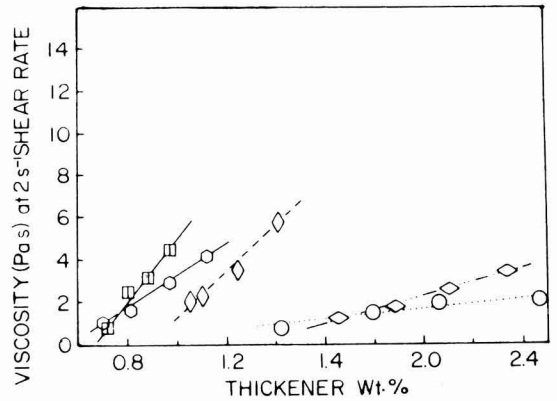


Figure 15. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 22% NVV/57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

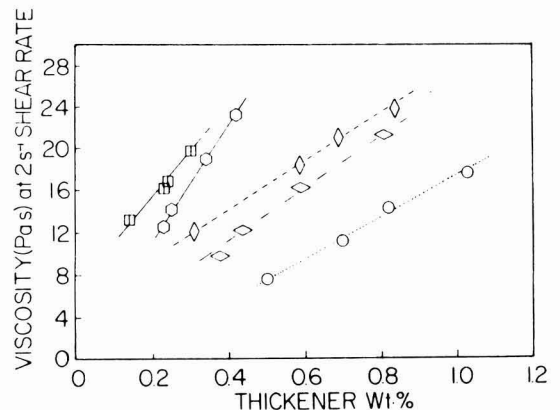


Figure 16. Low-shear-rate ($2s^{-1}$) viscosity (mPa.s) dependence on weight percentage thickener required to attain Stormer viscosities of 80, 90, 105 and 120 KU in 42% NVV/35 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

* The thickener symbols are as defined in Figure 1.

viscosities at 10^4 s^{-1} as well as 2 s^{-1} shear rate are provided in Table 4 for 57 and 35 PVC formulations. The dependence of this variable on formulation %NVV is illustrated in Figure 18 for the small all-acrylic latex coating formulations at a constant (57) PVC. Although this type of illustration provides a clear indication of the relative viscosifying ability of thickeners, mechanistic interpretation of the data is complicated for the following reason. Since the volume of the continuous phase decreases as the %NVV is increased, any thickener would be required in smaller amounts to achieve a given KU (previous thickener weight per cents were based on the total weight of a formulation, including the non-volatiles). In order to normalise the data, the w_h value is based on the weight of the continuous aqueous phase (100-%NVV) of the formulation (w_h^N , Equation 1), which is converted into a HSV efficiency factor through Equation 2 (density of the continuous phase is assumed to be 1).

$$w_h^N = w_h / (100 - \%NVV) \quad (1)$$

$$\epsilon_h = 1/w_h^N (\text{mPa.s/Wt.}\%) \quad (2)$$

The dependence of the normalised efficiency factor ϵ_h required to effect a 100 mPa.s formulation viscosity on %NVV is illustrated in Figure 19. Even in this normalisation analysis, the H-M, W-SPs, except for HEUR-200 exhibit a gradual increase in efficiency with increasing %NVV, reflective of a shift in mechanism, particularly with HEUR-100 at 42% NVV. The dependence of HSV efficiency factor (ϵ_h) on %NVV for the HEC-stabilized, vinyl acetate/acrylate latex at 57 PVC is illustrated in Figure 20. At 42% NVV an extreme sensitivity of ϵ_h to variation in the latex for HEC, HEUR 708 and SMAT thickened formulations is observed. This dependence is not apparent in lower PVC formulations; this is discussed in the matrix interactions section below.

A corresponding LSV efficiency factor can be defined using Equations 3 and 4:

$$w_1^N = 100 \times w_1 / (100 - \%NVV) \quad (3)$$

$$\epsilon_l = 10/w_1^N (\text{Pa.s/Wt.}\%) \quad (4)$$

where w_1 is the Wt.% of a thickener required to achieve 10 Pa.s formulation viscosity ($\gamma = 2 \text{ s}^{-1}$) above the non-thickened formulation viscosity. The normalised data are illustrated in Figures 21 and 22 for the all-acrylic, surfactant stabilized latex and the vinyl-acrylic, HEC-stabilized latex respectively. There is a strong parallel in ϵ_h and ϵ_l in the vinyl acetate/acrylate latex formulations. In the small-particle, all-acrylic formulations, a difference in ϵ_l exists between HEC and H-M, HEC formulations, irrespective of the %NVV, this difference is not evident in ϵ_h .

Interaction matrices

Small-particle, all-acrylic latex

It has been demonstrated in 25% total solids dispersions that associative thickeners adsorb on catalyst-stabilized, 300 nm all-acrylic latex particles⁶. In this latter study, the associative thickeners are displayed from the acrylic latex's surface when sodium lauryl sulphate is added. In a fully formulated coating, pigments of higher surface energy and various types of stabilizers are present. The degree of stability offered by dispersant formulation surfactants and

Table 4

Viscosities (mPa.s) of non-thickened formulations

| Latex type | | Small-particle all-acrylic | | HEC-stabilized vinyl acetate/acrylate | |
|--------------------------------|------|----------------------------|------|---------------------------------------|--------|
| Shear rate (s^{-1}) | | 10^4 | 2 | 10^4 (HSV) | 2(LSV) |
| PVC | %NVV | | | | |
| 57 | 22 | 2.0 | 5.0 | 7.0 | 640 |
| 57 | 32 | 8.0 | 14.0 | 15.0 | 2090 |
| 57 | 42 | 14.0 | 55.0 | 40.0 | 5820 |
| 35 | 22 | 2.0 | 5.0 | 7.0 | 230 |
| 35 | 32 | 7.0 | 15.0 | 13.0 | 550 |
| 35 | 42 | 15.0 | 63.0 | 34.0 | 1900 |

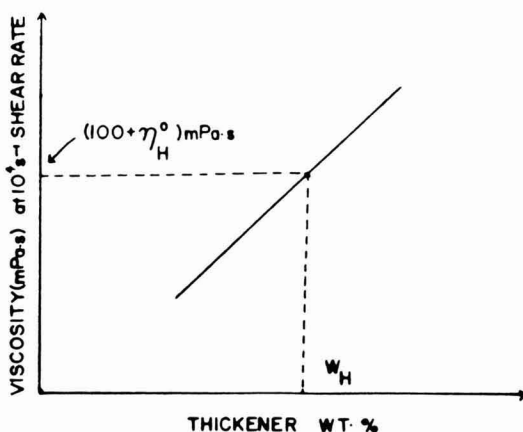


Figure 17. Illustration of the determination of w_h , the percentage weight of thickener required to thicken a formulation 100 mPa.s above its non-thickened viscosity at 10^4 s^{-1} shear rate.

η_H^0 is the viscosity of non-thickened formulation.

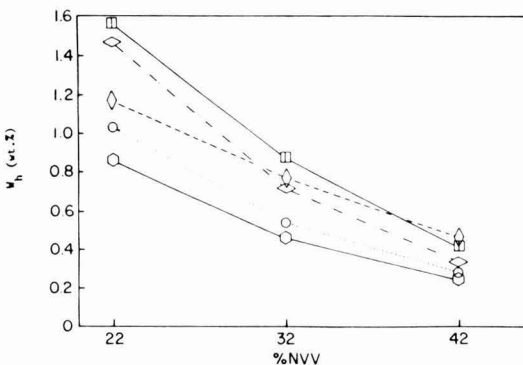


Figure 18. Dependence of w_h (illustrated in Figure 17) on %NVV in 57 PVC, small-particle, all-acrylic latex formulations*.

the overall interactions between the stabilized high surface energy pigments and water molecules will determine the degree to which associative thickeners will adsorb and stabilize such pigment dispersions⁷.

The average diameter of pigment particles (TiO_2) is generally higher than that of latex particles⁸, particularly in

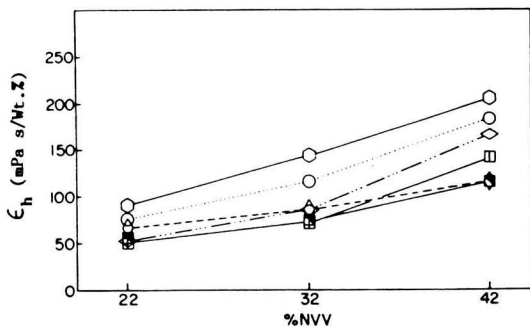


Figure 19. HSV efficiency factor (ϵ_h) dependence on %NVV in 57 PVC, small-particle, all-acrylic latex formulations*.

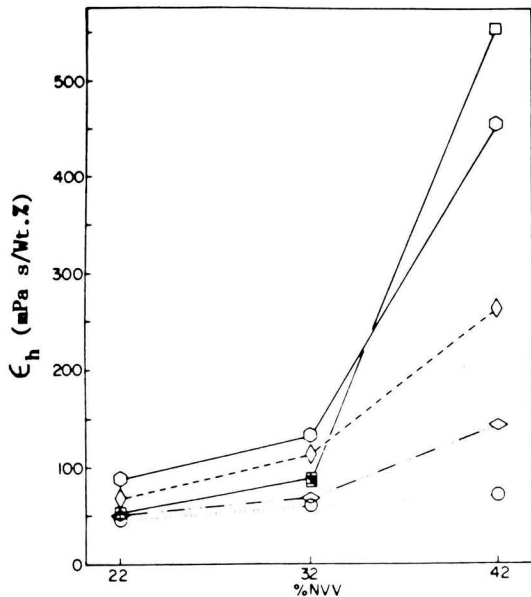


Figure 20. HSV efficiency factor (ϵ_h) dependence on %NVV in 57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

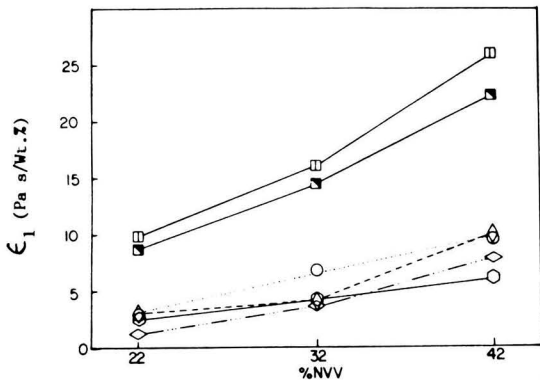


Figure 21. LSV efficiency factor (ϵ_l) dependence on %NVV in 57 PVC, small-particle, all-acrylic latex formulations*.

comparison to a small-particle-size latex such as the all-acrylic latex employed in this study. The average particle

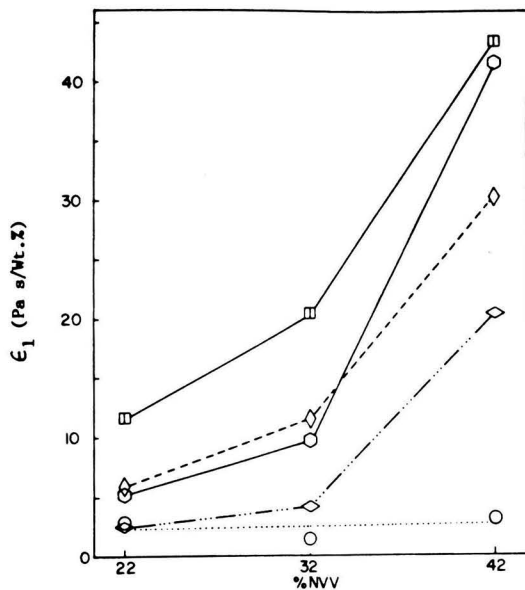


Figure 22. LSV efficiency factor (ϵ_l) dependence on %NVV in 57 PVC, HEC-stabilized, vinyl acetate/acrylate latex formulations*.

diameters of fillers are definitely higher than that of latex particles (by as much as ten fold or more⁸). Surface area calculations based on ideal spherical particle shapes indicate that the interactions between water-soluble thickener molecules and latex particles are statistically favourable over those between thickener molecules and pigment particles, even in the 57 PVC formulations. Similar calculations indicate that in a properly formulated system, there are several hundred water-soluble thickener molecules (actual number depending on various parameters such as thickener molecular weight, concentration, particle sizes of latex and pigments, PVC, etc.) per each dispersed particle. These analyses suggest the viability of one of the thickening mechanisms, whereby the HSVs of the formulations are increased due to the enhancement of hydrodynamic volumes by the adsorption of thickener molecules on the dispersed components.

The complexity of a fully formulated coating can provide a matrix of different associations which cannot be directly addressed. One manner in which to obtain subjective insights into the nature of interactions among various components is to graphically compare the high and low shear viscosity efficiency factor of a thickener as a function of changes in %NVV and PVC (Figures 23 to 32).

The interaction matrices for the formulations containing the small-particle, all-acrylic latex are illustrated in Figures 23 to 30. In formulations containing the greatest amount of water (22% NVV) there are no significant variations in the performance of a given thickener with changing PVC. Distinct differences among the thickeners are evident. All of the thickened formulations have two points in common:

1. As the %NVV is increased, the viscosity efficiency parameters increase. The increase is insensitive to variation in the PVC level in the high shear analysis, except with the lowest molecular weight HEUR 100 coatings at 32 and 42%

* The thickener symbols are as defined in Figure 1.

NVV, where a nonlinear increase is observed with decreasing PVC.

2. A dramatic increase in the low shear efficiency value is observed in all thickened formulations with decreasing PVC as the %NVV increases.

HEUR 708 exhibits a greater high shear efficiency value in 22% NVV than the other formulations (Figures 23-26) and maintains this difference with increasing %NVV. This suggests a strong association in the HEUR 708 coatings due either to interassociation of thickener molecules (leading to a greater effective hydrodynamic volume) or to associations with the dispersed components (leading to a greater effective volume fraction). The contributions of both associations are probably involved in the matrix of increasing thickener concentrations in a specific formulation (which affect gloss readings¹) with increasing %NVV and PVC.

Greater low shear efficiency values are observed in 22% NVV HEC thickened formulations (Figures 27 to 30) and are maintained relative to the other coatings with increasing %NVV. This would be expected if a volume restricted flocculation of dispersed components were in effect at low shear rates. The low values observed in the hydrophobically-modified, water-soluble polymer thickened formulations suggest associations with the dispersed components, providing osmotic stability in the lower %NVV formulations. The increase in the low shear efficiency parameters with a decrease in PVC in the 42% NVV coatings suggest flocculation of the latex.

The heterodispersed, HEC-stabilized, vinyl acetate/acrylate latex was examined at three %NVV levels but only at two PVC (57 and 35) levels. The matrix dependence for the four thickeners is presented in Figures 31 and 32. The 22 and 42% NVV formulations at 35 PVC were prepared with a different production sample of vinyl acetate/acrylate latex. A smaller particle size, HEC-stabilized vinyl acetate/acrylate latex is under investigation, and will be reported in a future part of this series. There are, however, several general observations that can be made regarding the differences in thickener performance with respect to the small-particle, all-acrylic latex.

The efficiency values of the 22% NVV formulations do not change dramatically with changes in PVC, and their magnitudes are similar to that observed in the small all-acrylic formulation. The change in the HSV efficiency factor with increasing %NVV is relatively minor with HEUR 100, unlike the profile noted with the small latex. They are extremely high in both the HEC and the HEUR 708 formulations in the 42% NVV. In the 42% NVV coatings, the highest efficiency values, at both high and low shear rate, are observed at the highest PVC, in dramatic contrast to the sensitivity observed in the small particle, non-HEC-stabilized latex coatings. The latter differences are in accord with the DLVO theory. In the crowded formulations (volume fraction = .42) with the small-particle acrylic, surfactant-stabilized latex, the latex flocculates; in the larger, heterodispersed and osmotically stabilized vinyl/acrylic latex formulation, the TiO₂ flocculates.

Conclusions

The complexities encountered in mechanistic interpretation of data obtained from concomitant changes in both the

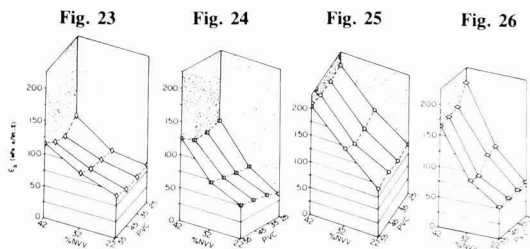


Figure 23-26. HSV efficiency factor (ϵ_h) dependence on %NVV and PVC in small-particle, all-acrylic latex formulations thickened with: (Figure 23) HEUR 200, (Figure 24) HEC:MHR, (Figure 25) HEUR 708, (Figure 26) HEUR 100*.

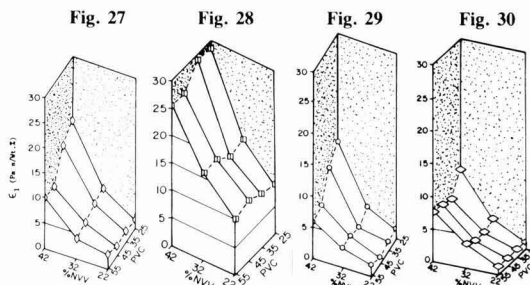


Figure 27-30. LSV efficiency factor (ϵ_l) dependence on %NVV and PVC in small-particle, all-acrylic latex formulations thickened with: (Figure 27) HEUR 200, (Figure 28) HEC:MHR, (Figure 29) HEUR 708, (Figure 30) HEUR 100*.

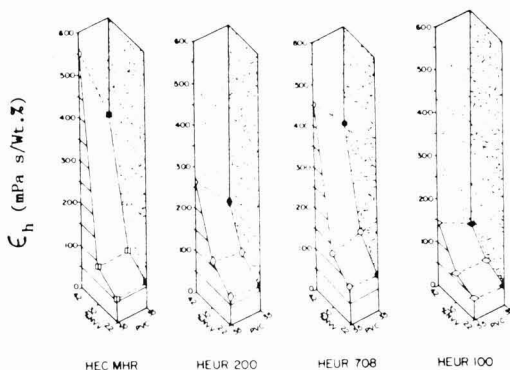


Figure 31. HSV efficiency factor (ϵ_h) dependence on %NVV and PVC in HEC-stabilized, vinyl acetate/acrylate latex formulations. (Closed symbols represent a different latex production batch)*.

%NVV and the PVC of coatings can be resolved by employing HSV and LSV efficiency factors (ϵ_h and ϵ_l). ϵ_h and ϵ_l for most of the thickeners examined exhibit a greater sensitivity to changes in %NVV than to PVC. These studies are complicated by extender pigments with much larger-particle size than TiO₂ or the latex which are present in the systems. This complexity will be addressed in future studies. Surface area comparison of the components statistically favours interaction of the thickener molecules with the latex rather than the pigment. Several examples are given, suggesting that with some thickeners the interaction occurs preferentially with the pigment. In crowded formulations, thickener-dispersed component

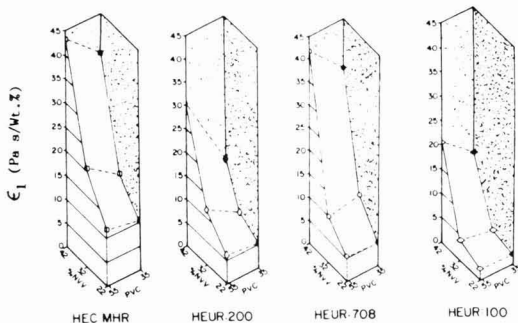


Figure 32. LSV efficiency factor (ϵ_1) dependence on %NVV and PVC in HEC-stabilized, vinyl acetate/acrylate latex formulations. (Closed symbols represent a different latex production batch)*.

associations are not sufficient to inhibit flocculation. In such systems the latex will flocculate if not sufficiently stabilized. This is in part due to the manner in which coatings are formulated. Less thickener is required to achieve a given KU viscosity with increasing %NVV. In the higher %NVV formulations the surface area of dispersed components is greater but there is less H-M Thickener present for interaction. If the latex is hydrophilic and stabilized by chemically-attached nonionic water-soluble fragments, the pigment is flocculated.

Acknowledgement

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Characteristics of a Nigerian kaolinitic clay mineral extender for paints

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Abstract

China clay type extenders for paint can be produced from Nigerian kaolinitic deposits. The characteristics of these clays are not only comparable to the commercial grade china clay but satisfy most of the requirements of British Standard 1795 (1965) specifications for china clay extenders used in paint manufacture.

Introduction

Clays as minerals are generally common and may be found in most geological settings. However, their types, chemical, mineralogical composition and relative abundance are the key determining factors for their economic exploitation. Large deposits of kaolinitic or china clay exist in different places in Nigeria, viz: Oza-Nagogo, Agbor-Alisimie, Okigwe etc. Studies by the department of geological survey have shown that these deposits are present in sufficient quantities and in a suitable quality for the manufacture of building bricks, ceramic wares, engineering materials etc¹. It is clear, however, that kaolinitic clay can also be utilised in many other ways, for example, as extenders and fillers in paints, inks, paper and other polymeric systems. In paints, clays, although present in small doses, play a vital role in not only reducing cost but also enhances application properties such as brushing, levelling etc. Theng², has summarised these uses.

Although the existence of Nigerian kaolinitic clay deposits has been known for decades, no systematic characterisation of their extending properties for coatings seems to have been carried out.

In this study, Nigerian (Agbor-Alisimie) kaolin clays are characterised for their suitability as coatings' extender.

Experimental

Materials

The raw clay used for these studies was obtained from Agbor-Alisimie, a town located 58km east of Benin City, Nigeria. Samples were collected in hand-dug pits.

Extraction process

The clay was crushed, separated from gross impurities and size graded by wet refining.

Calcined clay

Calcined refined clay was produced by heating at 850°C in a Muffle furnace for 5 hours. This method is similar to the method used by Huxtable and Pickering³ for the production of soaked calcined clay.

Physical analysis

Physical analysis involved the determination of the moisture content (by oven drying), oil absorption (spatula rub-out method), specific gravity (pycnometer method) and particle size distribution by wet sieving and pipette analysis. Most of these physical tests were carried out using British Standard (BS) 1795, 1965 methods⁴. Surface areas of clay were measured by glycol adsorption method as described by Dyal and Hendrick⁵, and also by methylene blue method⁶.

Clay mineral species identification was carried out using Philips PW 1140 diffractometer with Cu k-alpha radiation at a scanning rate of 2° 2θ per minute. Quantitatively, the relative amounts of the various clay mineral species were obtained by comparison of peak area percentages.

Chemical analysis

Organic content was obtained by ignition loss, matter soluble in water as BS 1795, and Na₂O AND K₂O by Gallenkamp flame analyser (Model FGA 330-C). Other chemical components of the clay were determined using the Pye Unicam SP 2900 atomic absorption spectrophotometer.

Results and discussion

Particle size distribution

The particle size distribution curve of the wet refined clay is shown in Figure 1, and the proportions of the various size ranges are listed in Table 1. Although the data obtained indicated that the Nigerian clay was slightly under the BS 1795 (1965) specification requirements, the bulk, however, consists of fines less than 200 μm. Sieve analysis curve (Figure 1) also show that the majority of the samples contain high proportions of the fine material. The rest of the material is considered to be coarse.

Physical properties

Clays used in paints are available in a variety of grades:

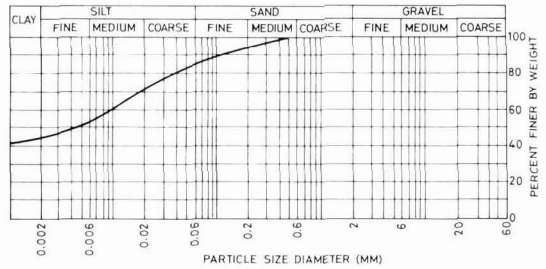


Figure 1. Particle size distribution curve of Nigerian kaolin clay

calcined, water washed, classified etc. In this study, only the first two grades are considered alongside the commercial grade China clay.

Specific gravity

Data on specific gravity (Table 1) showed some difference between the natural raw clay and the calcined clay. The low value shown by calcined clay has been attributed to surface dehydroxylation³ followed by structural expansion which increases voids. However, the specific gravity values obtained satisfy the requirements of BS 1795, 1965 and ASTM⁷ specifications for china clay used as extenders in paints.

Surface area

Results of glycol retention and dye adsorption experiments are summarised in Table 1. The surface areas of the refined clay calculated from glycol retention data are 10.93m²/g and 6.8m²/g for raw and calcined clays, respectively. Values obtained using methylene blue method are 16.65m²/g for raw clay and 7.13m²/g for calcined clay. In both methods, the surface area of the calcined clays diminished to very low values, indicating a reduction in sorption and lower organophilic character⁵. Huxtable and Pickering³ have indicated that this type of calcined clay (referred to as soaked clay) is the most suitable form of clay used in latex emulsion paints.

Table 1

Clay: Analysis to BS 1795 "Extenders for Paints", 1965

| Clay | Test | | | | | | | | | |
|------------------------------------|------------------|-------------------------|----------------|-------------------|------------------------------|--|-----|----|---------------------------------|-------|
| | pH of aq. slurry | Solubility in water (%) | Oil absorption | Specific gravity | Matter volatile at 105°C (%) | Particle size distribution min. % wt. finer than | | | Surface area* m ² /g | |
| | | | | | | 20μ | 10μ | 2μ | GY | MB |
| Specification requirements | 4.5-8.0 | Max. 0.5 | By agreement | ASTM D603 2.2-2.6 | Max. 2 | 90 | 70 | 15 | — | — |
| Calcined clay | 5.0 | 0.68 | 54 | 2.42 | 0.5 | — | — | — | 6.8 | 7.13 |
| Raw refined clay (finer than 20μm) | 6.13 | 0.10 | 44.6 | 2.12 | 1.67 | — | — | — | 10.93 | 16.65 |
| Commercial China clay (Lawrence) | 6.5 | — | 54.3 | 2.36 | 1.0 | — | — | — | — | — |
| Raw Clay | — | — | — | 2.61 | — | 74 | 62 | 45 | — | — |

* GY = Surface area determined by glycol adsorption method.
MB = Surface area determined by methylene-blue method.

As can be seen in Table 1, the pH values of the aqueous suspension of the clay minerals are comparable to the commercial grade China clay and within the limits specified by BS 1795, 1965 i.e. 4.5 to 8.0. Notably, the calcined clay gave the lowest pH value. This result is in good agreement with the observations of Mortland and Raman⁸, and Frenkel⁹, indicating that a clay becomes more acidic as it is dehydrated. This they attributed to increased Bronsted acidity produced by ionizing effects of charged cations, which is more pronounced with smectitic clays than the kaolinitic type.

Oil absorption (OA)

The oil absorption values ranged from 54 for calcined clay to 44.6 for the raw clay and with the commercial grade having a value of 54.3 (Table 1). Specification requirements of OA values of clay extenders are by agreement. However, the OA values are important parameters in coatings since they affect the critical pigment volume concentration (CPVC), which can be defined as the pigment concentration in the dried paint film where just sufficient binder is present to fill the voids between the pigment particles; the lower the OA, the higher the CPVC. Optimum performance regarding water permeability, rusting, blistering etc. is obtained when a paint is formulated at or near the CPVC¹⁰. Above the CPVC, it is found that a reduction in corrosion protection^{11, 12} is inevitable, probably due to insufficient medium to fill the pigment voids.

Chemical properties

Table 2 shows the chemical components present in the Nigerian (Agbor Alisimie) clay samples and their proportions. As can be seen in the table, the absence of SO_3^{2-} (sulphite) and the very low content of Fe_2O_3 (less than 1%), imply that a corrosion free system can be conceived.

Loss on ignition (LOI)

The loss in weight of the dried clay mineral on ignition, shown in Table 1, is within the BS 1795, 1965 specification requirement, i.e. 0.4 compared with a maximum requirement of 14.

Matter volatile

The percentages of volatile matter of the clay minerals listed in Table 1 are 1.67 for raw clay, 0.5 for calcined clay and 1.0 for the commercial grade China clay. The BS 1795, 1965 specification requirement for clay extenders for paints is a maximum of 2%.

Matter soluble in water

BS 1795, 1965 specification requirement for matter soluble in water of China clay extenders for paints is 0.5% maximum. The raw clay gave a value of 0.10% and the calcined clay a value of 0.68%. These are shown in Table 1.

Clay mineral content

X-ray diffraction traces (Figure 2) of the clay show that kaolinite and smectite are the only clay minerals and quartz the only non-clay mineral present. The majority of the

Table 2

Chemical properties of clay material

| Components | Percent by wt. |
|--------------------------------|----------------|
| SiO ₂ | 48.35 |
| TiO ₂ | 0.01 |
| Al ₂ O ₃ | 36.44 |
| Fe ₂ O ₃ | 0.57 |
| CaO | — |
| MgO | 0.28 |
| Na ₂ O | 0.09 |
| K ₂ O | 0.02 |
| SO ₃ ²⁻ | 0.00 |
| LOI* | 0.4 |

* Loss in weight on ignition

Table 3

Mineralogical composition of the raw and refined clays

| | Raw clay | Refined clay (finer than 20 μ m) |
|-----------|----------|---|
| Kaolinite | 78 | 90 |
| Quartz | 13 | — |
| Smectite | 9 | 10 |

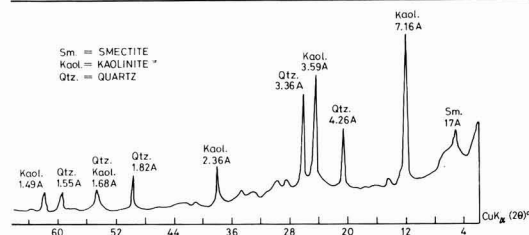


Figure 2. Glycolated X-ray diffraction trace of the 20 μ m fraction of Nigerian kaolin clay

peaks are due to the presence of kaolinite ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$), as shown in Figure 2. The minor constituents such as smectite and quartz have their own characteristic peaks with the expected lower intensities. As seen in Table 3, the total mineral content of the raw refined clay is about 90% (w/w) and that of the raw unrefined clay 78% (w/w). These are considered very high even though there are no BS specifications for kaolinite content of China clays.

Conclusion

This work has clearly shown that the Nigerian (Agbor-Alisimie) kaolin clay is technically comparable to the commercial grade China clay, and satisfies majority of BS 1795, 1965 specification requirements. Judging from its properties, the Nigerian kaoline clay can be classified as China clay extender grade 3 in accordance with BS 1795, 1965 specification.

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next month's issue

The Honorary Editor has accepted the following papers for publication in the November issue:

Relative tolerances in CMC colour-difference formula for paint samples by *O. Adebayo and B. Rigg, School of Colour Chemistry, Bradford University, UK*

Aspects of labelling and related legislation for supply and conveyance by *D. Cornelius, Cray Valley Products, Farnborough, UK*

The application of colour physics to printing inks by *J. H. Nobbs, Colour Chemistry Dept., Leeds University, UK*

Ultra-violet curing for offset printing inks and varnishes by *C. G. Roffey, National Printing Ink Co Ltd, Chichester, UK*

Hazardous raw materials used in the paint and ink industries by *I. Scott, formerly ICI Paints, Slough, UK*

letters

BSI Committee M/2 Colour Difference Equations

Sir,

As the newly appointed OCCA representative on this committee, I would like to ask for the help and support of members who have experience in the application of colour difference measurement in the surface coatings industry, and any in quality control and management who see a need for a national standard to be used in surface coatings.

The committee is newly formed, and is yet to meet, but it seems likely that it may select an established colour difference unit, for example CIELAB already widely used in

the textile industry, to set up a national standard.

I will be very pleased to receive guidance and comments from members, either by writing to the address or calling the telephone number given below.

10 Ravenswood Drive,
Cheadle Hulme,
Cheadle,
Cheshire SK8 7DZ
Tel. (061) 485 2257.

*Yours faithfully,
D. A. Plant*

27 August 1986

occa meetings

Auckland Section

Chrome pigments

The Auckland Section held a meeting at The Sorrento on 19 August 1986. 41 members were present including five students of the Surface Coatings Diploma. The speaker was Peter McAndrew of Lockfast Chemicals.

Mr McAndrew was the top student in 1985 in the Surface Coatings Diploma course. As part of the course he had done a project on Chrome pigments and his talk involved an outline of the tests carried out and the conclusions he had drawn from these.

He had found that as dispersion time of the pigment

increased, the resultant film had a higher gloss, better hiding power and better resistance to alterations in colour on exposure. Increased dispersion or grinding darkened the initial colour of the paint but did not impair durability.

There was much interest in this topic and members discussed the graphed results at length. Of special interest was the theory on the relationship between particle size of the pigment and the resulting opacity of the paint.

A vote of thanks and congratulations were given by John Hudson.

Alan Sheath presented Tom Hackney with his Fellowship Certificate (FTSC) and congratulated him on his achievement.

H. Simes

JOCCA

Blanc Fixe Micro[®] provides the finest solution to dispersion problems.



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|---------------------------------------|---------------------|-------------|
| BaSO ₄ Content | Approx 99% | (DIN 55911) |
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| Specific surface area | 3 m ² /g | (DIN 66132) |
| Oil Absorption | 13 g/100g | (DIN 53189) |
| Dispersibility | Excellent | |
| Gloss | Very good | |

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- Gravure printing inks
- Adhesives

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APPLICATION

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ICI buys West German subsidiary of Inmott

ICI has purchased from BASF the West German subsidiary of Inmott in a deal worth between £15-20 million. This follows on from the recent ICI acquisition of Glidden for £390 million. The Inmott purchase reinforces ICI's position in the West German automotive paints market. Inmott GmbH had a turnover last year of £25 million, two-thirds of this came from the vehicle refinish paints sector.

BP Acetic Acid US deal

BP Chemicals Americas has been given exclusive marketing rights to the product from the acetic acid plant at Sterling Chemicals Inc Texas City site. The £490 million per year acid plant is one of the largest acetic acid plants in the world.

Blythe Burrell Colours closure

Blythe Burrell Colours will cease to trade in the near future and the Company's sites at Millwall and Stockport will close. Blythe Burrell colours will complete orders already placed and will accept practicable orders during the run-down period. In a consultancy agreement Ciba-Geigy will manufacture and supply those products which were a key feature of the Blythe Burrell range.

DeSoto buys into Dufay Titanine

DeSoto Inc, of Des Plaines, Illinois, the sixth largest US paint manufacturer has purchased a 50% interest in the NE of England based speciality industrial paint manufacturer, Dufay Titanine plc for £4m. Dufay Titanine plc has now changed its name to reflect the new change in ownership to DeSoto Titanine plc and will continue to operate from Shildon, County Durham.

DSM Resins acquires Resicoat

DSM Resins BV with headquarters at Zwolle (The Netherlands), the Resins Division of the Dutch chemical group DSM, has taken over the West German company Resicoat GmbH from Bosch of Stuttgart. Resicoat will form part of the powder paint activities of DSM Resins BV.

products

New Glasurit adhesion promoter

Glasurit Valentine of West Drayton has launched a new adhesion promoter to use with polyurethane reinforced synthetic enamel paint. The *Synthetic Adhesion Promoter 200-23* improves adhesion between existing paintwork in good condition and subsequent coats of enamel paint. It allows refinishers to respray vehicles without the need for sanding down to bare metal.

Reader Enquiry Service No. 30

Paint Open Tech – a continuing success

Open Tech in Surface Coatings Technology, launched two years ago by the Paintmakers' Association with the active support of the Manpower Services Commission, is a continuing success story.

For the period March-July 1986, 116 students enrolled for modules of this unique distance learning scheme. Of that total, 40 were new entrants. The drop-out rate has remained consistently low with 93 per cent of those enrolled still studying. At present, the total number of students who have started studies is 206. Module Certificates have been awarded to students upon completion of all relevant assessments.

All projected modules will have been prepared and ready for students by the end of 1986. Latest in the series is Module 05 (Modifiers) for which students can enrol in September. This, like Module 06 (Evaluation) requires 30 hours of study compared with the other modules, all of which require 60 hours for completion. The remaining modules are Module 07 (Convertible Media) and Module 08 (Formulation Principles).

Paint Open Tech has obvious appeal to students (of all ages) in the paint industry and that is where most of them have originated. The scheme also has value for those in industries supplying raw materials and services to the paint industry, and to users of paints – especially Modules 01 and 02 dealing respectively with the principles of paint technology and paint application.

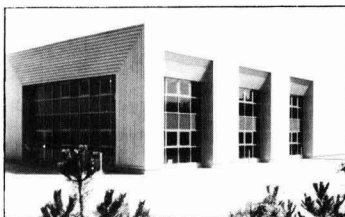
The scheme is not restricted to the UK alone and a number of enquiries for details have been received from overseas, especially from countries where UK-based parent companies have subsidiaries.

For further details about Autumn enrolment contact: The Paintmakers' Association, Alembic House, 93 Albert Embankment, London SE1 7TY.

ICI coil coatings

Phase one of the 13 acre first stage of the new Leeds Business Park has been completed at Bruntcliffe Lane, Morley. The site area when fully developed will cover 25 acres. The picture below shows one of the two blocks which make up this initial phase – Unit A, 7057m² including 884m² of offices. These blocks were planned on a modular system and the walls consist of an external skin of BSC longrib 875 coated with *ICI Fluorolux PVF2* coil coating paint in Metallic Bronze (available from ICI, Slough) and an inner lining of scanrib 1000.

Reader Enquiry Service No. 31



Leeds Business Park coil coated with ICI Fluorolux PVF2

Hoechst new wax for inks

Hoechst UK Ltd of Middlesex have added *Ceridust 9630F* to their range of wax additives for inks. This product imparts scuff and abrasion resistance to printing inks.

Reader Enquiry Service No. 32

Low viscosity agitator

John Godrich of Ludlow has available the *Jorgensen Rapidex* agitator. This low viscosity agitator can mix up to 25,000 litres and uses the hydrodynamic 'Berthou'

propeller for pumping power.

Reader Enquiry Service No. 33



Seoul Olympic Stadium coated with Pliolite

Goodyear Olympic Pliolite

Paints produced by *Korea Tex Cote Corporation* and based on *Goodyear Pliolite* resins have been used for the stadium in Seoul where the 1988 Olympic Games will be held. Sand-coloured *Tex-Cote* paint will cover the massive concrete facility that stands 47m high and 2km circumference.

Reader Enquiry Service No. 34

BP's solvent replacement for EGA

BP Chemicals of London has added *ethoxypropyl acetate (EPA)* to its range of propylene glycol ethers and esters. Produced by the esterification of ethoxypropanol (EP) with acetic acid, EPA has been developed specifically in response to demands for a direct replacement for ethyl acetate (EGA). EGA is used widely in

paint and ink systems where it is normally the last solvent to evaporate from the film. BP Chemicals research has shown that EPA is a near perfect match for EGA in all key areas.

Reader Enquiry Service No. 35

Spillage remover

Gotec Trading Ltd of London has available a chemical absorbent powder for mopping up chemical spillages called Rench-Rapid. This compound, a phenolic condensate can deal with spillages from hazardous chemicals to oils, paint and inks by spreading the powder across the liquid.

Reader Enquiry Service No. 36

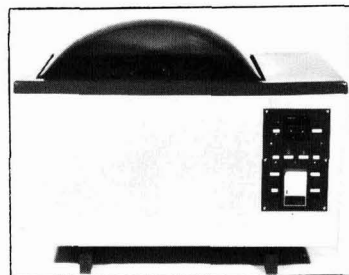


Mopping up with Rench-Rapid

Sheen salt spray corrosion test cabinets

Sheen Instruments of Teddington has introduced two salt spray corrosion test cabinets called Model SF/450 and SF/1000 with 450 and 1,000 litres capacity respectively. These cabinets are designed to comply with BS 3900 F12.

Reader Enquiry Service No. 37



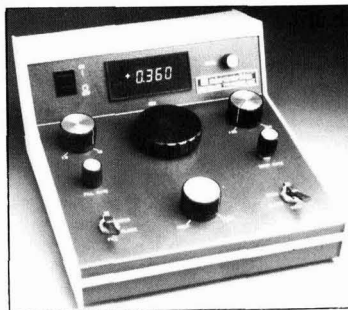
Sheen salt spray corrosion test cabinet

Arco new ink solvent

Arco of Eton has available a new prop-

ylene glycol mono ethyl called Arcosolv PE to be used as a substitute for EE (ethyl-glycol ether) in printing inks.

Reader Enquiry Service No. 38



1305 Multivolume Pycnometer

Coulter pycnometer

Coulter of Luton has available the Micromeritics 1305 Multivolume Pycnometer. The 1305 provides rapid volume measurements of dry powdered, or solid samples, from which the true density is calculated. The instrument has a choice of three sample holders, with a maximum capacity of 150 cc.

Reader Enquiry Service No. 39

New emulsion thickening agent

Allied Colloids, General Industries Division, of Bradford, has introduced a new alkali activated associative thickener for emulsion paints called Rheovis CR. It is an acrylic copolymer emulsion developed to replace the higher spattering conventional cellulosic thickeners in medium to high p.v.c. emulsion paints.

Reader Enquiry Service No. 40

literature

US adhesives and coatings market survey

A recent survey by Kline of Brussels forecasts US demands for speciality adhesives and coatings for polymer composites is to reach US \$110 million by 1995 up from only US \$35 million in 1985, equivalent to an average growth rate of 12.1% annually. Liquid, paste, and film adhesives together account for 85% of the total US market in 1985 with the balance represented by speciality coatings. The majority of these speciality adhesives and coatings are based on either epoxy or polyurethane technologies. Growth will vary significantly depending on the end-use industries employing these products.

Film adhesives are positioned to ex-

perience the fastest growth due to new-generation military aircraft production. Growth in speciality coatings will occur from the increased use of fiberglass reinforced plastics for exterior automotive body panels. Finally, liquid/paste adhesives will experience increased consumption, principally from automotive applications.

The new Kline survey is now available on subscription from: Kline S.A., Rue Froissart 89, B-1040 Brussels, Belgium.

SERVO formulations

Celebrating their 60th Anniversary SERVO bv delden of Holland have published a booklet on "Primary formulations for various coatings in conjunction with SERVO Coating Additives". This booklet (101pp) contains formulations of aqueous gloss-paints, primers, enamels, inks, etc. Free copies are available from: SERVO bv delden, POB 1, 7490 AA Delden, Holland.

meetings

Fluid Rheology Course

Warren Spring Laboratory, Stevenage, will be holding a five-day course from 17-21 November 1986 on Fluid Rheology covering the technique and measurement of rheological properties, their subsequent uses and the latest concepts in the field of applied rheology. In addition practical hands-on experience will be gained with a wide range of viscometers and rheometers. Lectures include: Physical/chemical basis of rheology, thixotropic measurement, rheology of high solids, etc. The cost of the course is £925 + VAT (incl. accm.) and further details can be obtained from: Warren Spring Laboratory (Attn. Miss P. Madhvi), Gunnels Wood Road, Stevenage, Hertfordshire SG1 2BX.

people

Dr Chris Sghibartz and Dr Allen Barnatt have been appointed Business Development Managers at RTZ Chemicals Ltd.

John Cawte has been appointed Director of Exports of Berger Britain. Succeeding Mr Cawte as Managing Director of Cuprinol will be Phillip Medcaff.

Peter R. Gribble has been appointed Associate Director-Industrial Coatings and Carlos E. Ortiz has been appointed Technical Manager-Powder, of the Research Centre of Glidden Coatings & Resins, Strongsville, Ohio.

Dr W. Karl Olander has been named Director of PPG Industries Principal Chemicals Research and Development Centre, located in Barberton, Ohio.

London Section

National Golf Tournament

Once again the London Section golf day, held on 2nd July, was blessed with ideal weather and some 43 members and guests enjoyed the facilities provided by Canons Brook Golf Club. Thirty-six of those actually played or walked the course whilst others viewed their activities in some cases with amusement, in others with amazement.

The winners were as follows:

National Trophy — Jim Berry, Manchester Section, 35 points.

London Section Trophy — Brian Mayhew, Manchester Section, 32 points.

Visitors Trophy — Alan Swales, Manchester Section, 36 points.

Martin Stevens was actually a joint winner for the London Section Trophy but lost out by one point on the back nine and commiserations are extended to him.

The prizes were presented by London Section Chairman Ken Arbuckle and due to the generosity of members and their companies, almost everybody went away with some memento of the occasion.

The day was completed with a dinner in the club-house which was of the usual high standard.

D. Bannington

Posthumous degree to Betty Ray

Many members will recall that Betty Ray, wife of Stanley Ray (a former chairman of the Midlands Section) died two years ago, two days after having completed a Master of Arts thesis from her hospital bed. In July this year the University of Birmingham took the unusual step of paying tribute by awarding a posthumous degree so that her achievement could be "acknowledged, proclaimed and recorded" and Stanley Ray received the degree on her behalf.

Obituaries

Dr John Cutter

Dr L. A. O'Neill writes:

Dr John Outram Cutter (JOC), Chief Chemist at the Paint Research Station from 1927 to 1942, died on 5th February 1986, aged 91.

JOC did as much as any man to change the art of paint making into a science, firstly in his function at the PRS, and

secondly as a result of his renowned lecture course on Colloid Chemistry at the Borough Polytechnic, which was attended by many of those to come to the forefront in paint technology.

Opinions on JOC varied widely throughout the industry. If you expected a literally correct answer to a straight question, you were often disappointed; if you took the answer as a general guide to point you in the right direction, his advice could be invaluable. He had an intimate knowledge of the academic world and knew which of the University research schools were leading the field. This resulted in a strong academic content in the early PRS publications.

JOC left the PRS in 1942 to join Turners Asbestos, eventually ending his career at Goodlass Wall, engaged mostly on colour theory problems.

JOC was a great believer in a balanced diet, well before it was fashionable. It is interesting that most of those (including Dr Jordan) who scoffed at 'Cutter and his lettuce leaves' left this earth many years before JOC.

The last news we had of JOC, a few years ago, was that he was reasonably fit and lucid, but had become increasingly deaf.

I received much help and inspiration from JOC in my early years in paint research, which is one reason why I remained in the field. His last advice to me was 'never to make the mistake I did, and retire to an area where most of the population is above retiring age'.

Ernest Farrow

Mr P. L. Gollop writes:

Ernest Farrow died on 11 July at the age of 68 after a very short illness following a cerebral haemorrhage.

With his passing his wife and family lose a devoted husband and father, his friends and colleagues a most genial companion and adviser, and OCCA a stalwart supporter.

Ernie was born in India and received his initial education there at La Martiniere College. In 1935 he began his 44 years in the paint industry as technical/commercial assistant for Silver Town Lubricants of Calcutta, an associate of Hoyle Robson Barnett, which later became part of British Paints India Company.

But it was not until 1939 that he joined British Paints in their R & D Laboratories

at Newcastle and began his 40 year association with the BJN group of Companies. After studying at the Rutherford College of Technology and gaining his HNC he progressed through the various divisions of British Paints and finally became Technical Manager responsible for all their technical activities, including those of elastomers and resins.

When the industrial work of British Paints was transferred to the BJN laboratories in London he was moved to Stratford to coordinate the amalgamation of the Industrial Technical Divisions of J & N, Lewis Berger, British Paints and John Hall into the new Berger Group. This he did most successfully and retired as Technical Manager of their Industrial Division in 1979.

In his succeeding years he acted as a consultant to various companies in Berger's overseas division and in that capacity visited a number of their factories, including those in Brazil, Nigeria and Malaysia.

He was always a keen and enthusiastic OCCA member and occupied many offices including that of Chairman (1965-67), Coordinating Technical Officer (1959-64) of the Newcastle Section, as well as being a member of the Technical Committee from 1978 to 1985.

In his spare time he took part in many sporting activities, being particularly good at cricket and swimming. Latterly he took up golf, but was not able to play to the extent he would have liked due to a developing infirmity in his leg.

Ernie will probably be best remembered with affection by all who knew him for his own particular charm and a style of leadership which was all his own. He never told his subordinates to do things — he always asked them to help him and this they willingly did. As a friend and companion he was always good company and had a talent for making things go.

For this and many of his other likeable attributes we shall sorely miss him but never so much as will his wife, Georgina, his daughter whom he saw receive her PhD in Canada a few weeks before he died, his son and grandchildren and Georgina's children.

To them all we extend our deepest sympathy.

OCCA Ties are now available from the Association's offices, with a single Association Insignia on either a blue or maroon background. The price is £4.25 each (including VAT) and orders (**prepayment only**) to Priory House.

new members

Ordinary Members

Barker, C (*Transvaal*)
 Barry, T A, MSc (*Irish*)
 Collins, J J (*London*)

Davis, K A, BSc (*London*)
 De Jonge, G J K, BSc (*Transvaal*)
 Evans, P G (*Manchester*)
 Gad, H H, BSc (*General Overseas—Egypt*)
 Gibb, S J, BSc (*Wellington*)
 John, E C (*Transvaal*)
 Lumley, I D (*Newcastle*)
 Meisel, N (*Transvaal*)
 O'Brien, A B, BSc (*London*)

Quigley, S P (*Irish*)
 Stonecrest, P J (*Wellington*)

Associate Members

Graham, D M (*Wellington*)
 Khan, W A (*General Overseas—Pakistan*)
 Spencer, S J (*Manchester*)
 Young, J P (*Wellington*)

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT



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Becker Industrial Coatings have an opening for an Analytical Chemist in the Technical Department of their Plant at Speke, Liverpool. Applicants for this position should be academically qualified to at least HNC standard or equivalent. They should have a number of years analytical working experience, which should include experience in the use of GLC, Infra Red and Atomic Absorption equipments. An application form is obtainable upon written request from the Personnel Manager at the address below.

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Please apply in writing, giving details of age, qualifications and career to:

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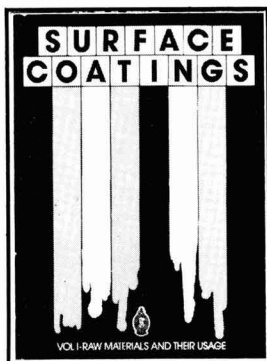
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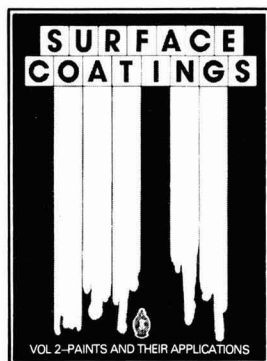
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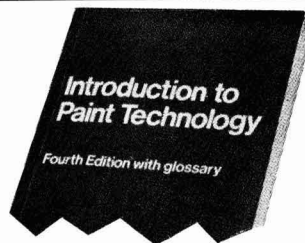
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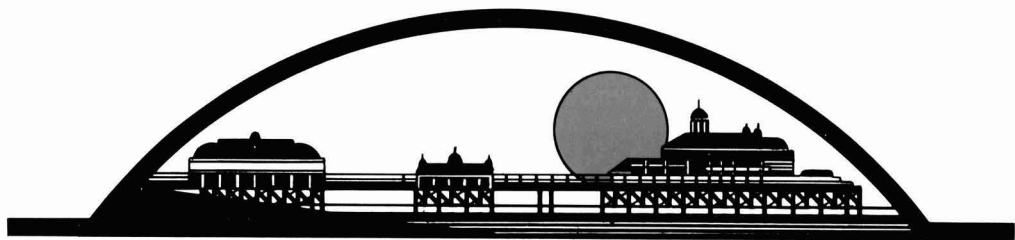
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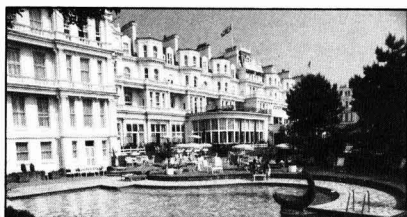
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The objectives of the Conference will be to review the advances made in the science and technology of surface coatings in both the commercial and academic fields and it is intended to encompass as wide a field as possible in the paint, printing ink and allied industries. Attention will also be directed to future possible trends and implications in these industries.

The Honorary Research and 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 and Secretary, Oil and Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, UK. (Tel: 01-908 1086. Telex: 922670).

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The future of the coatings industry depends upon technological advances.

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The seventeen invited papers, from organisations foremost in the field, cover all aspects – from raw materials to the formulation of coatings and the performance of films. We believe that the presentations at this Conference contain the seeds from which major developments of the next decade will grow.

The Conference will be of paramount importance to anyone whose future lies in the coatings industry.

To celebrate its Sixtieth anniversary, the Paint RA has organised this International Conference by inviting contributions from paint producers and suppliers in Europe, the USA and Japan.

As President of Paint RA, I commend the event to you all – Members and non-Members alike.

The Coatings Industry can only grow through technological advance.

I look forward to welcoming you in Brussels.

John M. Rackham

John Rackham
President Paint RA

J.O.C.C.A 69(10) 1986

Conference Programme

SESSION 1

Monday 3 November 1986
13.30 - 17.45

Chairman: **Mr John Rackham**
*President,
Paint RA*

Paper 1 **Photoinitiated Cross-Linking of Polymers: Curing and Surface Reactions**

Atmospheric oxygen retards photoinitiated curing. A new range of photoinitiators has been developed which forms a dense surface polymeric network which excludes oxygen and allows curing to proceed unhindered.

Paper 2
Thermal Analysis in the Coatings Industry
The quality demands of modern paints and coatings are very high. In order to cope with these still increasing demands it is necessary to have a better knowledge of the materials. Thermal analysis is one of the possibilities for finding out more about the fundamental characteristics of these materials. Three methods will be presented: DSC (Differential Scanning Calorimetry), TMA (Thermomechanical Analysis) and DMA (Dynamic Mechanical Analysis). By measuring a different physical property, each of these techniques can be used in research and quality control.

Paper 3
The Chemistry and Process of Group Transfer Polymerisation
Group Transfer Polymerisation is a new type of addition polymerisation useful for polymerisation of acrylate and methacrylate monomers. GTP gives living polymers of high stability and can be carried out at room temperature or above. Polymerisation involves the repeated transfer of a trialkyl-silyl group from the living chain end to the incoming monomer. Polymerisation is initiated by a silyl ketene acetal but a catalyst is also required for the reaction to proceed. GTP provides a unique degree of control over the molecular weight of the polymer chain, allows introduction of other groups in the building of the polymer backbone in a way never previously possible, and unprecedented control over the configuration of end groups in the polymer.

Paper 4
Acylurethanes: Curing Agents for Powder Coatings
The use of blocked isocyanates for cross-linking hydroxyl-functional binders has been established for many years. Considerable efforts have been made to develop faster deblocking systems, thereby lowering baking temperatures. It has been found that changes within the isocyanate-carrying structure can accelerate unblocking. Acylurethanes of aliphatic di- or polycarboxylic acids in which the acyl group is the activating species have been investigated.

Paper 5
Advances in Fluoropolymer Coatings
A newly developed fluoropolymer paint curing at ambient temperature will be described. It can be applied to metal, cement and plastics substrates and cures to a highly weather-resistant film.

Paper 6
Water-Based Basecoat for Automotive Industry
There have been many problems with water-borne coatings for the car industry, particularly the influence of humidity on the drying process. These have now been overcome by the use of a novel aqueous microgel technology which has enabled satisfactory water-borne basecoats for basecoat plus clear systems to be formulated. Application, drying, processing and handling will be discussed.

Paper 7
The Use of Acrylic Copolymers in Can Coatings
Many solvent-borne polymers have been used for separating contents from container in the beverage industry. With the rapid emergence of the 2-piece metal container and pollution abatement legislation in the USA in the mid 1970's, the water-

Prof. Bengt Rånby
*Dept of Polymer
Technology
The Royal Institute
of Technology
SWEDEN*

Dr Paul Cuypers
*Coatings Research
Institute
BELGIUM*

Dr John A Simms
*F&F Products
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Mr Masaaki Yamabe
*R&D Division
Asahi Glass Co Ltd
JAPAN*

Dr Joe Pearson
*ICI Plc-Paints World Group,
WEST GERMANY*

Mr Peter V Robinson
*Polymer and Coatings
Research
Glidden Coatings and
Resins USA*

SESSION 2

Tuesday 4 November 1986
09.00 - 13.00

Chairman: **Mr John Bernie**
*Managing Director
Paint RA*

borne epoxy-g-acrylic technology came to dominate this industry. The epoxy-g-acrylic copolymer comprises approximately 80% epoxy resin and 20% acrylic polymer. Attempts have been made to design water-reducible acrylic copolymers for the beverage industry with little success. It was believed that acrylic copolymers would have significant performance capabilities if only the serious deficiencies of currently available acrylics could be overcome and attempts to do this will be reported.

Paper 8

Tough, Highly Flexible Surface Coatings for Coil Applications

With the ever increasing demand for surface coatings of superior flexibility and abrasion resistance within the coil industry, an investigation of fundamental polymer design has been carried out. Surface coatings of superior flexibility and anti-abrasion characteristics have been developed. Certain coatings of this generic type exhibit weathering properties of considerable interest.

Dr Alan Harrison
Coil Coatings Group
International Paint Plc
UK

Paper 9

New Concepts in Decorative Coatings Formulation

Embrittlement after exposure, leading to eventual failure by cracking on dimensionally unstable substrates such as wood, can be substantially reduced by structural changes in the alkyd or by the inclusion of specially designed polymer dispersions. Incorporation of solubilising groups can be used to either reduce solvent content or enable change to isoparaffinic solvent without loss of solids content. Unlike low molecular weight alkyds, drying performance is unimpaired. Advances in thixotropy can control application properties and reduce sensitivity to temperature changes and tinting colour dispersions.

Mr Graham North
Cray Valley
Products Ltd
UK

SESSION 3

Tuesday 4 November 1986
14.00 - 17.45

Chairman: Mr Dick
Woodbridge
Vice-President
Paint RA

Paper 10

Newly Developed Inorganic Coating Materials

A new inorganic coating material (CELA) and a new organic-inorganic composite coating material (COSMER) have been developed. CELA is based on polysiloxane chains and has a good film formability. Because of its highly cross-linked film, CELA has excellent heat resistance, weather resistance, anticorrosive, water-repellent and stainproof properties, etc. Many new avenues of use for CELA, such as heat-resistant coatings and water-repellent materials for concrete are being opened up. COSMER is a chemical compound consisting of colloidal silica, organosiloxane and organic polymers. Because of its film formability and flexibility caused by organic polymers and hardness and heat resistance caused by inorganic polymers, COSMER has excellent adhesion to metals, anticorrosive properties, scratch resistance, non-inflammability, etc.

Mr Osamu Isozaki
Kansai Paint Co Ltd
JAPAN

Paper 11

Computer Colour Matching at Outlet Stores

The Computer Colour Matching system to be described consists of a commercially available spectrophotometer, a microcomputer with graphics and printer, a modem to communicate with a host computer, an interface that allows communication between the various components, and the software. The user-friendly software provides the operator with options to compute the usual array of colour and colour difference scales for the common standard illuminants and observers. These values, colour plots and spectral curves are displayed and printed for hard copy. Colour matching is done by accessing the appropriate programme on the host computer. This colour matching programme will match any colour that falls within the colour gamut of the colorants of the tinting system. It will compute the least metameric and the lowest cost match from a set of colorants using a combinatorial routine. Hiding power information is also computed.

Mr Charles J Sherman
Color &
Standards Lab
The Sherwin-Williams
Company
USA

SESSION 4

Wednesday 5 November 1986
09.00 - 13.00

Chairman: **Dr Jim Coldrey**
*Immediate Past
President
Paint RA*

Paper 12

Characteristics of Air-Drying High - Solids Alkyd Paints
The development of a less polluting solvent-borne paint system for the European market is essential. Such a system has been achieved by making use of special low viscosity alkyds with increased reactivity. This has resulted in a commercial high-solids solvent-borne paint meeting the requirements for the German Blue Angel label (less than 15% solvent). Some interesting phenomena observed during the development work will be reported.

Dr Klaus Zabel
*Sikkens BV
THE NETHERLANDS*

Paper 13

Correlation of Accelerated Weathering with Outdoor Exposure

It has been found that in many cases the weathering data for coatings obtained under different conditions can be related by a single number, the Acceleration Shift Factor (ASF), which is test and material dependent. Its early estimation can permit durability prediction.

Dr John A Simms
*F&F Products
Department
E I Du Pont de
Nemours & Co Inc
USA*

Paper 14

Modern Approach to Anticorrosive Coatings

The mechanism of corrosion of ferrous metals is well established but the mechanism of protection by anticorrosive coatings is less certain. The use of many of the well-known anticorrosive pigments is now severely restricted on toxicity grounds. Recent progress with some of the newer pigments, e.g. those operating by an ion exchange mechanism, as well as experimental products developed at the Paint RA, will be reviewed.

Mr John Bernie
*Managing Director
Paint Research
Association
UK*

Paper 15

Pigment Thickener Interactions in Emulsion Paints

The influence of pigment dispersion on both gloss and opacity in emulsion paints containing associative thickeners was investigated. Pigment dispersion was assessed by measuring the flocculation gradient and by examination of portions of etched films under a scanning electron microscope. Studies of thickener adsorption onto pigment have also been carried out. The work demonstrates that the dominant factor in achieving good pigment dispersion is the type of emulsion used, although the thickener type can also have an effect.

Mr Iain Melville
Dr Leslie A Simpson and
Mr Luigi Cutrone
*Toxide Group Plc
UK*

Paper 16

New Applications of Small Polymeric Microvoids

The trend towards small polymeric microvoid technology has accelerated due to increased prices for titanium dioxide, improvement in the opaque polymer technology and the move to sales of paint by volume rather than weight. The formulation of paints meeting the requirements of the interior paint market for colour, hiding and washability will be discussed.

Dr John W Hook
*Rohm and Haas Co
USA*

Paper 17

Predispersed Polyethylene and Waxes in High Performance Coatings

Polyethylene, natural and synthetic waxes, silicones and other lubricants have been used for years to lower the coefficient of friction, increase apparent film hardness and improve a variety of surface properties of coatings. A wax predispersed in an appropriate solvent or solvent/vehicle blend can provide improved ease of incorporation, greater efficiency, broader range of effectiveness, and more trouble-free usefulness than other types of slip additives. This paper will illustrate the uses of waxlike additives and demonstrate the advantages of predispersed waxes.

Mr Conrad Harington
*Daniel Products Co
USA*

Who's Who

BERNIE, John was, before joining Paint RA as Managing Director in April 1986, Head of National Corrosion Service with responsibility for initiating this Government Advisory Service to Industry and for the further development of major collaborative research programmes. Author of numerous papers, he was actively involved in establishing an "Expert System Club" in association with AERE Harwell.

BRINDOEPKE, Gerhard (Dr) was educated in the Technical University of Berlin where he obtained a Master and Doctorate of Science. He joined Hoechst in 1980 and is currently working on crosslinking possibilities of functional polymers.

BURNS, Peter is Chief Executive, Paint and DIY Products Group, Reed International Plc, where he is also a Member of the Main Board. He is a graduate of Liverpool University and joined Crown Decorative Products in 1971 after a spell of 12 years in the USA. He served as President, Paintmakers Association (1984-85) and is currently a Member of CEPE (European Committee of Paint, Printing Ink and Artists' Colours Manufacturers' Associations).

COLDREY, Jim (Dr) was educated at the University of Nottingham and has worked for Blue Circle for the last 18 years. Past President of Paint RA, Dr Coldrey has been very active with various committees of Paintmakers Association, Paint Industries Club, and BSI.

CUTRONE, Luigi after graduating in chemistry from McGill University, he joined MF Paints in Laval where he headed the R & D Dept. For five years he was supervisor of application development at Tioxide Canada. He is now manager of application development, weathering and industrial sections at the Central Laboratories.

CUYPERS, Paul (Dr) obtained a PhD in organic chemistry at the State University of Ghent in 1982 and joined the Coatings Research Institute. His main research interest is thermal analysis of coatings, especially thermosetting systems.

HARINGTON, Conrad joined Daniel Products in 1957, and has travelled extensively in 60 countries as technical representative for paint and raw materials. He has presented papers at seminars and conferences in 12 countries in 6 languages. He is now overseas Technical Sales Manager.

HARRISON, Alan (Dr) after graduating in Mathematics and Chemistry, he continued his studies in surface science under the supervision of Prof. D T Clark at the University of Durham. In 1981 he joined International Paint where he is now Manager of Development, Coil Coatings Group.

HOOK, John (Dr) was educated in the Universities of Chicago and Illinois, and joined Rohm & Haas in 1979, where he is currently a Research Fellow. He researched extensively on the application of microvoid hiding technology to latex paints. In 1984 Dr Hook was a co-winner of FSCT's Roon Foundation Award on light scattering in paints.

ISOZAKI, Osamu joined Kansai Paint in 1970 after graduating from Sophia University in Tokyo. He has been working in the field of synthetic resins. As a Senior Group Leader in R & D laboratory he is currently engaged in the development of new inorganic polymers and their application.

MELVILLE, Iain was educated in the University of Strathclyde and continued his studies on shear thickening polymer solutions at the University of Glasgow. He joined Tioxide Group in 1984 where he is now technical officer in the application development section.

NORTH, Graham is Managing Director of Cray Valley Products, having worked with the company in a variety of technical and management roles since leaving school. He is a graduate of London University and the Harvard Business School and has served as Treasurer of Paint RA and Chairman of British Resin Manufacturers' Association. He has lectured in many subjects, such as industrial thixotropy, electro-deposition, radiation curing and two-component acrylics, in some 16 countries.

PEARSON, Joe (Dr) joined ICI in 1974 after completing his BSc and PhD degrees at the University of Loughborough. After working in the electrocoat and coil coating areas, he was seconded to ICI's sister company ICI Inc, Canada, and then headed the Aquabase Team in North America. In 1984 he returned to Europe to head the Aquabase effort in Germany, where he is now based.

RACKHAM, John began his career as R & D chemist with a paintmaker and is now Tioxide's European Technical Service Manager. He is a Fellow of the Royal Society of Chemistry and is the current President of Paint RA.

RÅNBY, Bengt (Professor), after several years in USA Prof. Ranby organised and now runs the prestigious Department of Polymer Technology in the Royal Institute of Stockholm. He is recognised as one of the leading figures in polymer science. His books, monographs and numerous publications embrace all aspects of polymer chemistry – photochemistry, crosslinking, degradation, singlet oxygen etc.

ROBINSON, Peter was educated in England and after a brief spell with Styrene Co-Polymers, joined Glidden in 1969. He is a Fellow of Royal Society of Chemistry, ex-President of the Paint Research Institute (USA), and member of FSCT and the American Chemical Society. His present position is Associate Director, Polymer and Coatings Research, SCM Corporation.

SHERMAN, Charles after graduating from Ashland College, Ohio, joined Sherwin-Williams where he pioneered instrumental colour control and computer colour matching. Presently, he is manager of colour and standards laboratory and is responsible for the development and utilisation of colour technology.

SIMMS, John (Dr) was educated in Purdue University, Indiana. He joined F & F Department of E I Du Pont De Nemours, Wilmington, in 1956, being promoted to Research Fellow in 1980. His research interests include adhesion, adhesives, photo-oxidative degradation of polymers, acrylic copolymers, isocyanate, aziridine and epoxy chemistry. He is currently working on Group Transfer Polymerisation.

SIMPSON, Leslie (Dr) was educated in the Universities of London and Surrey. He joined Tioxide Group in 1973 where he is now Assistant Technical Service Manager. He has published various papers on gloss, metal marking and durability and has lectured at many major conferences.

WOODBRIDGE, Dick joined John Hall & Sons (now Berger) in 1941. He has been associated with a number of significant developments in the field of emulsion paint technology. Currently, he is Technical Director of Berger Decorative Paints, Bristol, and Vice-President of Paint RA.

YAMABE, Masaaki has worked with Asahi Glass for 20 years, where he researched on fluorine chemistry and was involved in the development of new fluoropolymers including ion exchange membranes, oxygen enrichment membranes and weather-resistant paint. He is now responsible for R & D of new organic materials.

ZABEL, Klaus (Dr) was educated in the Technical University of Berlin and joined AKZO Research Laboratory, Obernburg, in 1970 where he worked on antioxidants, chlorinated fatty acids and cellulose. He is now Research Manager, Trade Sales Paints, Sikkens BV, Sassenheim, Holland.

Conference Arrangements

Conference

It is anticipated that over 300 delegates will attend the Paint RA's Diamond Jubilee Conference; early booking is strongly recommended. With papers from the world's foremost companies, this Conference will provide an excellent forum for assessing today's creative advances for tomorrow's technical breakthrough.

Exhibition

The Resins & Pigments Exhibition, Europe's largest show for the surface coatings industry will be held in conjunction with the Conference. Over 100 leading raw material suppliers from 12 countries will be participating in this 2-day event.

Venue

(for Conference and Exhibition)

Both events (Conference and Exhibition) will be at:

**Brussels Sheraton Hotel and Towers,
Place Rogier 3, Brussels, Belgium.**

Situated in downtown Brussels, the Sheraton is within 10 minutes walking distance from the Grand-Place and 5 minutes from the North Railway Station. This station is on the main European railway network connecting Brussels with France, Germany, Italy, Netherlands, Switzerland etc. The airport is 30 minutes drive from the hotel. Frequent train services operate between the airport and North Railway Station.

Date and Time

| | | | | |
|--------------------|-------|-------|-----------|-----------------|
| Conference: | Start | 12.00 | Monday | 3 November 1986 |
| | End | 13.30 | Wednesday | 5 November 1986 |
| Exhibition: | Start | 09.00 | Wednesday | 5 November 1986 |
| | End | 17.00 | Thursday | 6 November 1986 |

Opening of Conference

| | | |
|------------------------|-------|---|
| Monday 3 November 1986 | 11.00 | Registration begins |
| | 12.00 | Buffet lunch begins |
| | 13.30 | Opening address by the President, Paint RA |

Papers and Proceedings

Joining instructions and Final Programme will be sent before the Conference. A List of Participants and Extended Abstracts of Papers will be issued at the Registration Desk on Monday 3 November. Selected Papers will be published in full in the Paint RA Progress Report.

The Duration of each paper will be 25 minutes followed by 10 minutes of discussion. There will be an 'open forum' at the end of each Session.

Travel and Hotel Arrangements

Flights will be made available from London (Heathrow and Gatwick), Birmingham, Manchester and Glasgow. All Conference delegates and speakers will be staying at the PALACE HOTEL (2 minutes walk from the Conference Venue, Sheraton). Brompton Travel (Paint RA's nominated Travel Agent) has negotiated a special reduced rate for those delegates needing accommodation at the Palace Hotel for the nights of 3, 4 and 5 November. The Palace is a 4 star hotel with 2 Bars and Restaurant. All rooms are with private bath and shower, colour TV, direct dial telephones, in-room bar, etc.

Cost:

| | |
|------------------------------------|------|
| 2 nights at Palace Hotel | £190 |
| 3 nights at Palace Hotel | £225 |
| 4 nights at Palace Hotel | £260 |

This cost includes:

- Economy class air travel from London – Brussels – London.
- Accommodation in single room at Palace Hotel.
- Full Breakfast.

Brompton Travel

- can book accommodation only
- can arrange flights from anywhere in the world
- can arrange train travel
- is also responsible for the special hotel package for the Exhibition delegates.

All enquiries regarding travel and accommodation should be made to:

Brompton Travel Ltd
204 Walton Street
Knightsbridge
London SW3 2JP
Telephone: 01 584 6143 (National)
+44 1 584 6143 (International)
Telex: 8951659

Registration Fees

Paint RA Member Companies

£196 for the first delegate
£180 for each additional delegate from the same Member Company

Non-Member Companies

£240 for each delegate
Fees include:
– Extended Abstracts of Papers
– Lunch on 3, 4 and 5 November

Applications should be made on the attached Registration Form giving full details. Do not send fees with this form. Invoices will be issued on receipt of the completed and authorised form. No cancellation can be made after invoicing; substitutions may be made at any time. Full Registration fees must be paid by delegates who do not wish to attend all 4 Sessions.

Conference Dinner

The Conference Dinner will be held on Tuesday 4 November 1986 at 19.30 at the Sheraton Hotel.

Cost: £27 per delegate
£27 per delegate's guest

Dress: Informal. Cost of dinner includes wine.

Guest Speaker: Mr Peter Burns, Chief Executive, Paint & DIY Products Group, Reed International Plc.

Ladies Programme

All delegates' wives and accompanying guests are invited.

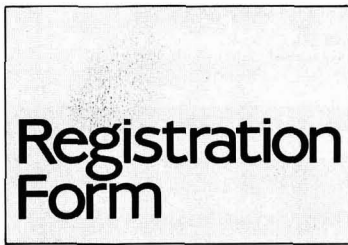
Provisional Programme:

Afternoon tea and welcome:
3 November

Coach trip to Brugge and Waterloo:
4 November

Conference Dinner
4 November (optional)

A small charge will be made towards coach trips



CREATIVE ADVANCES

in the

COATINGS INDUSTRY

3-5 November 1986 Sheraton Hotel, Brussels, Belgium.

Please print or type this form:

DELEGATE

| Serial No. | Name (Surname followed by first name) | Title (Dr Mr Mrs Miss or Ms) | Present Position | Place for Dinner YES or NO £27 Extra |
|------------|---------------------------------------|------------------------------|------------------|--------------------------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |

ACCOMPANYING GUEST

| Name (Surname followed by first name) | Title (Mrs Miss or Ms) | Guest of Delegate No. (See above) | Place for Dinner YES or NO £27 Extra |
|---------------------------------------|------------------------|-----------------------------------|--------------------------------------|
| | | | |
| | | | |

The Completed Form should be sent to:
 Mr Dip Dasgupta, Head of Information Department,
 PAINT RESEARCH ASSOCIATION, Waldegrave Road,
 Teddington, Middlesex TW11 8LD, England.

Authorised by:
 Invoice will be sent to this address.

Telephone: 01 977 4427 (National) +44 1 977 4427 (International)
 Telex: 928720

Name _____

Position _____

Company _____ PRA Member/Non-Member

Full Address _____

Tel. No. _____ Telex _____

Date _____ Signed _____

DO NOT SEND REMITTANCE with this form. Invoices will be issued on receipt of form covering the fee, and dinner.
 Contact BROMPTON TRAVEL for accommodation & travel.