The problems of painting over concrete and cement mortar
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PREFACE

Numerous problems associated with the painting of concrete have been brought to the attention of the Division of Building Research since its earliest days. That these problems do occur is understandable when one recalls the broad range of concrete materials available for various purposes which in turn may be painted with any one of several different types of paint.

This translation is of special interest in this regard and discusses the effect that such concrete characteristics as alkalinity, moisture and porosity can have on the performance of paints. The results of work that are reported on the use of form stripping aids with various paints are of particular benefit.

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THE PROBLEMS OF PAINTING OVER CONCRETE AND CEMENT MORTAR

Summary

The painter is more and more frequently confronted with concrete and cement mortar surfaces to be covered directly with paint products. This applies both to inside and outside work, and to on-site as well as prefabricated construction.

These materials present problems to the painter by reason of their porosity, alkalinity, moisture content and surface state.

Laboratories are particularly concerned with variations of moisture content and the danger thresholds, depending on the character of the paints. They study the possible effect of stripping products on the surface state and the adhesiveness of paints.

By taking into account the specific properties of these materials and the laboratory results supplemented by on-site inspections, valid solutions to most of these problems are available to the painter by selection from the various commercial products available.

Modern construction practices lead to the creation of ever larger surfaces of concrete and cement mortar which must be covered directly with paint. These include smooth or stippled stucco, trowelled or foamed cement, stripped concrete surfaces, concrete blocks, prefabricated parts, and asbestos cements.

In the not too distant past the use of paints was restricted to exterior stucco, and involved a limited number of familiar products which gave more or less satisfactory results, mainly silicate paints and oil emulsion paints. In the interiors of dwellings, cement masonry first received a coating of conventional plaster, and there was no particular problem concerning the choice of paints to be used.

We shall first study the various properties of these materials which the painter must take into account. A second part of the paper will then deal with the laboratory research carried out on these materials, and finally we shall review the main types of paints which will satisfy the requirements of the materials.

Properties of Concrete and Cement Mortars

We shall deal in particular with their porosity, alkalinity, moisture content and surface condition; in addition, we shall take up special applications, e.g. heated ceilings, where the temperature may have a considerable effect on the paints.

Porosity

All these materials are porous, but asbestos cement has a greater porosity than cement mortars and concretes, but not as great as cellular concrete.

In a given cement or concrete unit the porosity varies from place to place, and this may result in partial scaling of the paint where subsequent absorption of moisture occurs. This happens in asbestos cement panels even when they are painted on both sides while the unprotected edges are in contact with or close to structural beams laden with moisture. The asbestos fibres exert a wick-like effect and transport the moisture. Under these conditions impermeable coatings cannot be used. The absorption by the material should be reduced and controlled with the aid of a suitable sealer.

In the case of cellular concrete, structure necessitates thick coating with special cement paints having a high filler content.

Alkalinity

All cement based materials show a strong basic reaction due to the presence of free lime. Their alkalinities on the pH scale range from 7 to 14.

Alkalinity is especially dangerous when the support (concrete substrate) is green and moist. Over a comparatively long time, depending on the individual case, its chemical reactivity decreases. In particular, ventilation and porosity of the material greatly favour the carbonation of the free lime, whereas close stacking in poorly ventilated places is detrimental to this natural neutralization.

Sometimes additions of alkaline products for various purposes (antifreeze, workability aids, etc.) increase the alkalinity of the material and are detrimental to its natural neutralization. Asbestos cement, for example, maintains a high and prolonged alkaline reaction, despite its small thickness.

This aggressive chemical character prohibits the use of certain paints, especially those containing drying oils that are easily saponified, except on well-aged, very dry and well-carbonated surfaces. Generally speaking, neutralization should be promoted:

(a) by a suitable acid solution followed by careful rinsing. This method is always very dangerous;

(b) with magnesium or zinc fluosilicate solutions of variable strength.

It is preferable to use a neutralizing substance wherever there is any doubt about the neutrality of the material.

We shall see later that there is a range of products which can be used to paint cement mortars and concretes without regard to their alkalinity.

Moisture content

The moisture content varies depending on the character of the aggregates, the porosity of the material and its age. It is the moisture content which enhances the alkalinity of the concrete substrate and promotes saponification of paints with a oil binder base. In the saturated state these materials may have moisture contents normally between 6 and 12%, disregarding cellular concrete and asbestos cement, in which the moisture content may considerably exceed these figures.

As in the case of all porous materials, the moisture content is responsible for a large number of paint failures.

Various pieces of equipment based on different principles enable us to estimate the moisture content of porous materials. Their use is generally the prerogative of the laboratory technician. However, to some extent, the experienced painter is able to detect an insufficiently dry surface by various rules of thumb (cold to the touch, lack of hardness, the sulphur match test, where the match will light only on dry surfaces, etc.). On cement or concrete no empirical test is possible, because nothing outwardly distinguishes a dry base from a moist one.

The age of the material is no longer important in this respect and we have seen concretes which had been placed eighteen months and more on which failures occurred with certain types of paint, whereas nothing would have happened on plasters of the same age, for the simple reason that the concretes in question still showed considerable moisture content on inspection. Standard plaster coats in normal environment are perfectly dry long before eighteen months have passed. In this connection it should be borne in mind that cured concrete slabs do not lose their moisture by the process of curing, which is intended only to accelerate their setting and permit immediate handling.

Surface state

The adhesion of paints obviously depends on the condition of the surface. This may be stated as a general rule of painting regardless of the material employed.

Stuccos and concretes which exhibit a rough surface greatly favour the adhesion of coats of paints, whereas mortars placed into smooth forms (plywood, sheet metal) exhibit very smooth surfaces, except for the entrapped air voids that cannot be totally avoided. These surfaces are very satisfactory from the point of view of planeness, but painting them presents difficulties.

Such cast units can also exhibit more superficial local flaws, due to aggregate segregations and normally porous laitance accumulations. These tend to show a lack of cohesion and powderiness of the material in question.

Stripping compounds can aggravate this phenomenon, but the entire blame cannot be attributed to the form oil.

On the other hand, the technique of smoothing concrete surfaces by means of a wash, or cement grout, i.e. cement mixed with an excess of water, results in phenomena similar to the foregoing.

These powdery parts, without any consistency whatsoever, are generally lifted by the paints applied to them, and it is wrong to speak of removal of the surface material, because the flakes of paint take cement powder, sand or fine aggregates with them.

The painter should eliminate these powdery elements, not with a wire brush, as is most often done, but rather with a wet sponge, which will at the same time remove any form oil from the surface.

Special applications: heated ceilings

Concrete slabs containing hot water coils constitute a structural unit possessing the factor of "heat" in addition to the usual characteristics. Heat enhances the alkalinity of moist material and produces transfers of mass. In other words, water, in its liquid and vapour phases, migrates away from the warmer sections to the colder ones. These transfers of mass may cause blistering and detachment of the surface paint. At the same time temperature differences in space and time, owing to the expansions and contractions thus brought about, set up fatigue and aging stresses which tend to lift the paint. These phenomena can be of considerable magnitude if the coils are poorly placed in the slab, and if certain elements, because of this, are very close to the surface. In some cases it is practically impossible to paint without first applying a thick surface plaster.

Laboratory Experiments

In view of the possible failures noted, we wished to characterize the adhesion of various painting systems as a function of the factors which appear to us to be most important at the present time, namely moisture content and surface condition.

Adhesion is a tenuous, almost intuitive concept which is generally determined by chequering on a non-porous, e.g. metallic, surfaces. By scratching a grid down to the substrate, we produce small squares of paint which flake off more or less, depending on the tenacity of the coating. The adhesion is said to be good when the paint does not flake off at all, even when we try to remove the small paint squares either with the fingernails or by applying Scotch tape to the grid. This method, which is only qualitative and depends essentially on the scratching instrument and to some extent on a personal factor, fails completely in the case of porous substrates, regardless of their compactness.

We are at present developing a more objective, quantitative method in the laboratory. This may be described as follows (Fig. 1):

A circular metal pellet is glued with a suitable adhesive to the film of paint to be tested. The choice of an adhesive, of course, is very important, because at all costs the paint must not be affected, i.e. the adhesive must not react with the paint. We get satisfactory results by using epoxy resin glues without a solvent. The glue and its catalysts are mixed at the time of application and the pellet is glued to the coating by means of this mixture. The surface thus glued is detached from the surrounding parts by means of a sharp nail. A dynamometer is fitted to the pellet by means of a threaded rod. The glued coating is then stressed by pulling forces normal to the surface. The dynamometer needle shows the force in kilograms as it develops up to the time of rupture. The highest figure obtained at the instant of rupture is recorded. The result can be converted to kg/cm^2, and in this way characterizes the adhesion of the paint to the support.

Experience shows that this figure, which is variable, is practically always greater than 1 kg/cm^2 when the adhesion of the paint to the substrate is satisfactory. The tests, of course, are always repeated at least three times, and an average result is recorded. It is also possible by this method to determine whether the rupture takes place between different layers of the coating, or if the latter is detached from the substrate without modifying it, or if the forces of adhesion of the coating exceed the material to which the paint is applied, which sometimes breaks within the film. We have observed ruptures within asbestos cement, for example, in cases where the paint could not be detached from the support.

First experiment - on form oils

Some small slabs of concrete measuring 20 cm × 20 cm × 2 cm were poured from a mortar made up as follows:

Seine chippings 5 to 10..................................870 kg
Sand 0 to 5..910 kg
Cement C.P.A.C...350 kg
Water added to the dry materials.........................205 kg

So far ten products have been used to lubricate the metal moulds, five of them being non-emulsioned oils and the other five having the form of aqueous emulsions, in some cases mixed at the time of use. Three types of specimens were produced. One series was obtained without lubricating the moulds, another by lubricating the moulds according to the directions of the manufacturer, and a third series by using twice the amount of lubricant recommended by the manufacturer.

After stripping, the specimens were left to stand in the air for a minimum of one month, after which the exposed face received two coats of paint without priming of:

- a glossy glycerophthalic paint; or
- a glossy isomerised rubber base paint; or
- a Pliolite paint; or
- a flat chlorinated rubber base paint; or
- an oil base emulsion paint; or
- a polyvinyl acetate emulsion paint.

All the painted specimens were left to stand for about two months in the air before being tested.

The following observations were made:

- no spontaneous lifting of the paints was observed;
- the results of the stress tests as known so far are all very satisfactory.

The following is an example of the results obtained with one of these oils:

Paints used	Slabs poured without form oil	Slabs poured with double applications of form oil
Glossy glycerophthalic	9 kg/cm²	13 kg/cm²
Glossy isomerised rubber base	14.5 kg/cm²	11 kg/cm²
Pliolite	12.5 kg/cm²	11 kg/cm²
Flat chlorinated rubber base	12 kg/cm²	11 kg/cm²
Oil base emulsion	8.5 kg/cm²	8.5 kg/cm²
Polyvinyl acetate emulsion	not measured	16 kg/cm²

In the majority of cases the paint tore out surface elements from the concrete.

Incomplete as they are, these results are rather spectacular and show that the good quality paints normally employed in construction work have not merely satisfactory adhesions on cement mortars, but exceed the values that might have been expected a priori. It may also be noted that the variation in breaking loads bore no relation to the presence or absence of form oil.

The experiment is being continued and the complete results will be reported at a later date.

Second experiment - on the effect of moisture content

The tests were conducted as follows:

The small concrete slabs were poured, without the use of stripping compounds, from a mortar made up as follows:

$$\text{A mortar 1-3}\left\{\begin{array}{l}\text{Seine sand 0 to 5 : three parts by weight}\\ \text{cement C.P.A.C. : one part by weight}\\ \text{ratio of water to cement : 0,64}\end{array}\right.$$

The dimensions of the slabs were approximately the same as those used in the foregoing experiment. They were kept saturated with moisture for two to three weeks.

The faces and edges were painted, after which the specimens were dried carefully to the "desired" moisture content. Actually, in one series of tests the specimens are painted in the saturated state, while the others are brought to progressively lower degrees of moisture content in order to determine the critical points below which paints currently in use in the construction industry are no longer subject to failure. One coat of primer and two coats of paint were applied.

The following types of primer are employed:

- adhesive primer;
- primer with a vinyl emulsion binder;
- primer with a glycerophthalic varnish binder;

Five paints were tested:

- a glossy glycerophthalic paint;
- a flat glycerophthalic paint;
- a glossy isomerised rubber base paint;
- a flat isomerised rubber base paint;
- a vinyl emulsion paint.

A preliminary experiment was carried out on specimens kept at saturation (in the present case 10.6%) and on entirely dry specimens.

In this instance we did not apply a primer, but painted the specimens directly over the mortar, i.e. on the smooth stripped face, with two coats of glossy glycerophthalic paint. For the first specimens a bed of wet sand enabled us to maintain the moisture content during the painting operation and only the face in contact with the sand remained unpainted.

We found first of all that on the wet specimens the paint hardened very poorly, while its adhesion remained precarious and too slight for measurement by the tearing off tests. However, in the case of the dry specimens the paints hardened normally and apparently gave satisfactory adhesion, although we did not actually measure the breaking stress at this time.

The two series of specimens were exposed under infrared lamps in such a way as to obtain a surface temperature of 35 to 40°. After 24 hours' exposure no failure was noted. Water was then deposited on the surfaces exposed to the lamps and caused the paint to curl and swell only on the wet specimens; nothing happens on a dry specimen. The experiment is completed by supplying water again to the dry specimens, which are also moistened on the surface, and the paint curls and swells as in the case of the specimens kept continuously moist.

From this preliminary experiment it may be concluded that internal moisture in the concrete is detrimental to the good adhesion of paints, and moreover attacks them and prevents their hardening; blistering does not occur, however, unless condensations permit the formation of a bubble by plugging the capillaries in the paint. As far as paint applied to dry mortar is concerned, it is still sensitive to absorptions of water by the material and will blister as before when the capillaries are plugged.

Remarks

When we consider these preliminary tests together with failures that have occurred on site, we can already formulate the following observations:

(a) The stripping products normally used have no appreciable effect on the adhesion of paints, even when double quantities are applied, provided the prefabricated units, whether kiln dried or not, are correctly made up; the specimens poured in the laboratory prove this, but these are ideal conditions rarely realized on the job. If separations occur with large laitance outcroppings (laitance formed by cement and entrained by water is very porous and mechanically weak, and its formation can never be completely prevented), its mechanical strength is still further diminished by the presence of form oil on the surface.

Laitance alone is a poor enough support for the paint, but when it is accompanied by form oil it is fatal. The paint flakes off locally and takes powdery matter with it.

Form oils, even when used in double or normal proportion, do not appear dangerous to well-made units, but it may be assumed that with very large quantities the adhesion of paints might be seriously reduced.

(b) Moisture acts mechanically to oppose penetration by the paint and chemically by modifying its binder, mainly in the case of oil esters, by saponification or hydrolysis. Glossy paints, generally, are less permeable to water and will be subject to blistering, curling and swelling on surfaces frequently subjected to condensation in poorly ventilated kitchens and bathrooms.

Concrete walls will retain moisture for eighteen months and more; it is therefore absolutely necessary to use permeable systems with slightly saponifiable binders, or else to use a primer coat at least some tenths of a millimetre in thickness, not a simple surface finish, in which great thickness variations of some millimetres at right angles to slab joints of a few tens of microns, set up heterogeneous surface states which are generally detrimental to the adhesion of paints and superimposed their effects on those of moisture.

On-site inspections have shown that certain finishes comprising full primer coats covered with three coats of paint, even glossy paint, may be satisfactory when applied to concretes still containing 5% free water. Apparently a proper primer together with the intermediate coats of paint constitutes a barrier or a brake for the water beneath, and perhaps also for the lime in the water. The danger comes principally from the single glossy coat on a concrete which has merely been scraped by the painter. For paint systems which are sensitive to moisture we are unable to give a definite figure, but the tolerable minimum of moisture content would appear to be less than 4%. Certain authors give 3%.

Before concluding the present section it may be helpful to recall the apparatus which can assist the painter in recognizing the quality of the substrate.

Paradoxically, it is practically useless to mention the use of litmus papers or pencils, because we can always expect high pH values in cement mortars or concrete, and paints must be selected accordingly.

Resistance type moisture meters or constant dielectric apparatus used for measuring the moisture content of plasters can be applied here as well.

Paints to be Used on Concrete and Cement Mortar

The painter has considerable choice of paints for all these materials, but as usual it is wise to distinguish between exterior and interior work and finally certain special cases where the surfaces are not subjected to excessive weathering, but which must show a certain durability, for example stair-wells, public corridors and passages, and finally floors, which are exposed to particularly heavy wear.

External structures

Usually these involve rough concrete or stucco. One initial observation: cracks greater than 100 to 150 microns cannot be filled by paint systems, but require thick compounds, preferably reinforced, capable of attaining 300 to 500 micron widths.

The coating should not be expected to waterproof porous masonry surfaces. The paint can retard the penetration of water to a certain extent, but cannot completely prevent the passage of rain water if the masonry is a veritable sieve. Let us now consider the choice of paints.

On green or new concrete, silicate paints correctly applied can provide a durable coat, but it must be emphasized that the painter should make his own trials and use the products carefully; any carelessness in this respect can lead to disastrous results in the form of premature lifting or cracking. The repair of this type of paint poses delicate problems for the painter if he wishes to repaint with a different type of product. Polyvinyl acetate paints, or better acrylic resin paints, are recommended with differing results. Actually, each case is different and something that is successful one time may fail on another occasion.

On cement or concrete surfaces that have aged several months emulsion paints are currently being applied with binders ranging from drying oils through glycerophthalic resins, plasticized vinyl resins to acrylic resins. These paints will last satisfactorily on exterior surfaces for several years, provided the proportion of binder is adequate. By way of indication only, since this depends to a certain extent on the formulation, the dry weight of the binder should generally be at least 20%. Under these conditions, the paints in question are not flat, but satin. It should be kept in mind that the substrate must not be powdery. It must be firm and carefully filled with the fluidized paint, with water, or better, primed with a dilute resin emulsion. Powdering is fatal to these paints, and the more powdery the surface, or the earlier powdering occurs, the quicker their destruction. If the surfaces are clean and the paints are of good quality the adhesion forces may reach values that are rarely less than 10 kg/cm^2.

Flaking is due primarily to defects in the surfaces or to poor formulation of the paint (insufficient binder).

Among solvent paints we must single out the "Pliolites". These binders have a styrene-butadiene base, dissolved in white spirit. It is perhaps too soon for a final estimate of their quality, but even now they appear to possess a somewhat greater durability than the emulsion paints. They are practically unsaponifiable, which is not always true of the latter. Finally they are said to be capable of consolidating defective surfaces.

Also among solvent paints we should mention those containing oil varnish binders modified with artificial resins, e.g. oil soluble phenols, which were widely used until quite recently. These paints are subject to little saponification and have the great virtue that they wet the substrates thoroughly and are very weather resistant. They should receive greater use.

We should also mention, although they are still not very common, certain semi-thick complexes that can be applied by the painter. We refer to the multi-coat systems that can attain thicknesses of 500 microns and more. These are products generally with an aqueous emulsion binder and which contain not only mineral powders, but also either mineral or organic fibres. The coating produces a true stipple which is very weather resistant and which can effectively seal cracks.

By a different technique, a semi-thick coating can be achieved by dipping a fibre glass screen, or better a plastic fabric in a plaster, which is then covered with one or two coats of an emulsion paint. This method, which is applicable to old surfaces of mediocre quality, can also be used on new cement surfaces which show flaws. The painted coating can then be regarded as an organic reinforced microconcrete. The weather resistance is considerably increased by the thickness, and maintenance is limited to the repairing of the outside coats, since the permanent base is the reinforced plaster. These techniques, however laborious they may appear at first glance, are well repaid by the durability thus achieved.

The vinyl cement paints offer a simplified form of the semi-thick coating technique. These products come in two parts, a mineral powder comprising cement, mineral pigments, and dyes, which are mixed one-half hour before use with an emulsion binder. Two thick coats are applied to cover the cement or concrete surface. Fine finishing is not possible, but the durability attained at moderate cost renders them attractive. A coating of this type was used to cover the outside of the vault of the CNIT building.

One further word on the painting of precast concrete units.

Asbestos-cement boards are used as façade panels and large decorative units. Generally speaking they do not come within the purview of the painter, but are coated in the shop sometimes with opaque coloured polyesters, sometimes with isocyanate (polyurethane) paints, sometimes with epoxy resin paints, after which they are kiln dried or air dried. It should be kept in mind that these panels must not merely hide a surface, but must protect it and the edges so as to prevent the absorption of moisture or the occurrence of internal condensation which would result in the lifting of the veneer.

We conclude this section by warning contractors against the attractive but dangerous polychrome products, by reason of the chemical reactivity of the cement which if superimposed on weather effects tends to denature the pigment combinations sometimes very quickly. We must remain blind to certain hues which charm us, just as Ulysses had to close his ears to the sirens, and resign ourselves to tones which are often less luxurious, but more durable.

Interior structures

First of all I beg indulgence for a digression which is not without importance.

Theoretically, precast concrete slabs used in walls and ceilings are smooth enough to require no preparatory coats. The truth, however, is otherwise; some air voids are unavoidable, and the inevitable departures from flatness at the joints between slabs cannot be neglected without detracting from the overall appearance. The same applies to poured concrete structures, which will show ridges at the joints between forms, which the painter cannot remove. That is the way things are, not the way we want them to be. For these various reasons a so-called "raking" coat is usually applied which to some extent will fill up the voids and to some extent mask the joints. However, a plaster for filling never has the same properties as one used for covering; it is formulated either for the one purpose or the other and will then be a poor covering if it is a good filler or vice versa. This is not too serious a matter in waiting rooms and anti-rooms on unheated walls and ceilings, and lifting of the paint is unlikely. However, in rooms where condensations occur and on heated ceilings there is always a risk of this, in one case leaving the interior surface of the slab intact, while flaking will occur at the joints, and in the other case the blemishes will be reversed, but starting always from a point of intermediate thickness of the coat and spreading out towards very thin or very thick parts.

Under these conditions two general solutions are possible:

(1) direct application of paint to the concrete, with a sacrifice of appearance - a little later we shall see that this solution cannot be rejected out of hand; (2) application of a filling plaster by trowel or by spray to a depth of at least 5 - 10 mm, carefully following the direction of the supplier.

Having said this, we shall again find a goodly number of products that have already been mentioned. Generally speaking, the silicates are not acceptable for these purposes because of their unattractive finish. Rightly or wrongly the emulsion paints, and especially the vinyl, will take the loin's share. Their main advantages are ease of application, quick drying, richness and freshness of colour, and the absence of any unpleasant odour. Their disadvantages include susceptibility to soiling and poor washability. Apart from these considerations they are perfectly suitable for waiting rooms and antirooms, and all places unlikely to be subject to condensation. With certain reservations, however, they can also be used in kitchens and bathrooms. It is possible, of course, to use leaner formulae than for outside painting, but this should not be carried to the point of producing something like a sizing wash. These are cheap but more laborious to apply than ceiling white, to which they are in no way superior.

Glycerophthalic paints, either by themselves or with an undercoat of another type (emulsion for example). These come in flat, satin or glossy finishes according to requirements and taste. In kitchens and bathrooms on surfaces that are still moist, it would be wise to use the dull finishes. Glossy finishes are sometimes possible if a proven technique is followed, for example:

- a full plaster, not a filler;
- fine spraying;
- a coat of flat glycerophthalic paint;
- and a finishing coat of glossy glycerophthalic paint.

Isomerized or cyclized rubber paints in flat, satin or glossy finish. The same qualifications as above are applicable to the glossy finishes. These paints are not much used in residential rooms, but are useful in special applications, e.g. laboratories subjected to corrosive chemicals such as acid vapours or ferments (breweries, dairies, etc.).

Chlorinated rubber base paints are similar in their applications to the above, except that they are sometimes used in residences as vapour barriers or as insulators, thus making it possible to apply outercoats of oil base paints.

Special structures

Concrete floors are often given coats of very hard and easily washable paints, for example epoxy resin or isocyanate paints. These types have two components which are mixed at the time of use. Sometimes hard wearing powders, e.g. corundum, are added to them. The same paints can be advantageously employed in stair-wells, public corridors, classroom walls, etc. For these products it is important for the surface to be very dry, otherwise the paint will lift off immediately.

Certain emulsion paints, sometimes containing coloured plastic fibres, are applied in thick coats to hide surface irregularities by their texture, and show remarkable resistance to shocks, abrasion and various kinds of soiling, and at the same time they are decorative. Whether plain or in tints, these paints depend little on the dryness of the cement.

We conclude this section by touching on the question of swimming pools, reservoirs, water coolers and silos. Any such construction in concrete can be coated with paints having bases of epoxy resin, chlorinated rubber, polyvinyl chloride - vinyl acetate in solution or butyl rubber in solution. Except for swimming pools, certain bituminous or pitch paints with or without epoxy resins in solution, or emulsified pitch or bituminous products, can meet the same requirements. All these products must be very carefully applied in order to ensure satisfactorily impermeability.

Conclusion

To sum up, the problems posed by the application of paints to concrete and cement mortar come down to the following.

(1) Moisture content

This determines in large measure the choice of paints especially for interior work. The figures given below are not definitive, but serve as guides which may be revised in the light of experience.

Above 5% free water content in the material, only permeable systems, i.e. flat finishing paints, can be considered.

Between 3% and 5% permeable systems are still preferable. Glossy finishes should be rejected in most cases, except for certain specially designed complexes. Below 3% either permeable or impermeable systems are applicable.

(2) Surface condition

This determines whether a plaster must be used.

Filling. This is not advisable because of surface irregularities at right angles to panel joints, especially in kitchens, bathrooms and unheated ceilings.

Priming. This is recommended provided it is applied everywhere and thickly (500 microns, for example).

Veneering paints. They can replace the preparatory coat; they are applied directly in several coats, and in most cases their generally fibrous appearance will hide any surface flaws.

(3) The use of form oils

If the concretes are correctly made up there is no danger, provided no more than twice the quantity recommended by the manufacturer is used. It is wise, however, to clean powdery or doubtful surfaces with a wet sponge.

We have reviewed most of the problems posed by concretes and cement mortars and have attempted to resolve them. It would be presumptuous to claim that we have succeeded entirely, but we may hope that either new or old products used in the proper way can be of assistance to the painter and enable him to sustain his fondness for and pride in his work.

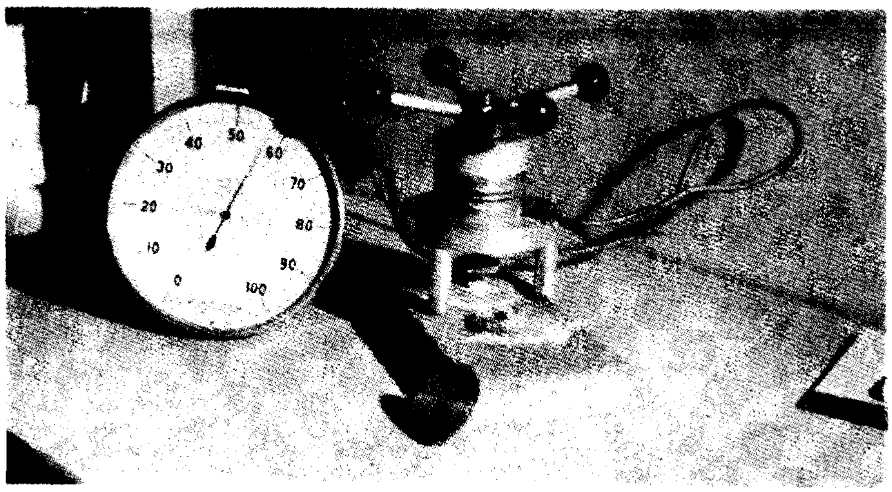

Fig. 1