Subject: Construction Materials

"Paints, Enamels and Varnishes"

(Dr. Muhammad Yousaf)

Paints, Introduction

- Paint is a liquid surface coating. On drying it forms a thin film (60-150 microns meter) on the painted surface.

CLASSIFICATION

- Paints in common use are classified as *oil paints, water paints, cement paints and bituminous paints*. There are some "special paints" used for special purposes e.g. heat resisting or fireproof paints, chlorinated rubber paints (for protection against acid fumes etc.), luminous paints (for visibility of painted surfaces in the dark) etc.

COMPOSITION OF OIL PAINTS

- Oil paints consist essentially of Base, Vehicle (always an oil, generally raw or boiled linseed oil), Colouring pigments, Solvent or thinner, Drier and Inert filler.

Paints, Constituents

- By suitable variation of the type and proportion of the various constituents the paints can be made dry, glossy or flat as desired. Other properties such as permeability to water could also be varied accordingly. All the possible constituents of paints are described in details below:

Base:

- The base, usually a metallic oxide, is the principal constituent of the paint. It makes the paint film opaque and possesses binding properties which reduce the shrinkage cracks in the film on drying. Some of the examples of base are white lead, red lead, zinc white, aluminium powder, iron oxide, etc. Lead based paints are in general affected by atmosphere and are not recommended for final coats. Zinc white is weather resistant. For inferior works Lithopone (barium sulphate chemically combined with zinc sulphide) is used for inside work.

Paints, bases

Characteristics of the more commonly used "*bases*"are discussed below:

- **White Lead:** This is a carbonate of lead and forms the base of lead paints. It is dense, permanent and water-proof. It is not suitable for delicate works as lead becomes discoloured when exposed to sulphur vapours. It is most suitable for wood surfaces; since it does not afford protection against rusting, it is not suitable for iron surfaces.
- **Red Lead:** This is an oxide of lead and forms the base of lead paints. It is most suitable for painting iron surfaces and for providing a priming coat to wood surfaces. It solidifies in a short time with linseed oil and hence, it is used as a drier also.

Paints, bases

- **Zinc White:**This is an oxide of zinc and forms the base of all zinc paints. It issmooth, transparent and non-poisonous. It is not decoloured when exposed to sulphurvapours. It is less durable and is difficult to work.
- **Oxide of Iron:** This is an oxide of iron and forms the base of all iron paints. The tint of paint varies from yellowish brown to black. It mixes easily with the vehicle. It is effective in preventing rusting of iron surfaces and is cheap and durable. It is generally used for priming coat of iron surfaces.
- **Titanium white:** This material possesses intense opacity. It is non-poisonous and provides a thin transparent film.

Paints, bases

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2.	Red lead	This is an oxide of lead and forms the base of lead paints. It is most suitable for painting iron surfaces and for providing a priming coat to wood surfaces. It solidifies in a short time with linseed oil and hence, it is used as a drier also.
3.	Zinc white	This is an oxide of zinc and forms the base of all zinc paints. It is smooth, transparent and non-poisonous. It is not discoloured when exposed to sulphur vapours. It is less durable and is difficult to work.
4.	Oxide of iron	This is an oxide of iron and forms the base of all iron paints. The tint of paint varies from yellowish brown to black. It mixes easily with the vehicle. It is effective in preventing rusting of iron surfaces and is cheap and durable. It is generally used for priming coat of iron surfaces.
5.	Titanium white	This material possesses intense opacity. It is non-poisonous and provides a thin transparent film. It is used for receiving the coat of an enamel.
6.	Antimony white	This is almost similar to titanium white.
7.	Aluminium powder	This forms the bulk of aluminium paints. It keeps moisture content of wood surfaces practically the same and also prevents cracking and warping of wood. It is generally used for a priming coat to new wood work.
8.	Lithophone	This is a mixture of zinc sulphide and barytes. It is similar in appearance to oxide of zinc. It is cheap and can easily be applied on the surface. However, when exposed to daylight, it changes colour, hence used for interior works only.

Paints, Constituents

Vehicle: Also known as binder, vehicle is an oil to which the base is mixed. It holds the constituents of paint in suspension and helps in spreading it over the surface to be painted, imparts durability, toughness and water proofness to the paint film and resistance to weathering and gloss to the painted surface and forms the body of the paint. Oils most commonly used as vehicles are: Linseed oil, Poppy oil, Nut oil and Tung oil.

- **Linseed oil**. It is the most widely used vehicle for all ordinary painting works. It is used either raw or boiled.
- **Tung oil.** It is far superior to linseed oil and is used for preparing superior paints.
- **Poppy oil.** Though its drying qualities are inferior to those of linseed oil still it is used for very delicate colours which last longer.
- **Nut oil.** It is almost colourless; dries quicker and is not durable. It is cheap.

Paints, Constituents

Colouring pigments:

- These are finely ground colouring matters. Their main function is to give colour and opacity to the paint. Pigments are liable to fade because of the bleaching action of sun rays. These are also subjected to change of colour under the influence of moisture, heat etc. Commonly used pigments are: Lamp black, vegetable black, ivory black, Indigo, prussian blue, copper sulphate, red lead etc.

Solvent or thinner:

- These are the oils used to thin the paints, increase the spread, and are also known as thinners. They make the paint of workable consistency and evaporate during drying of the film. The common thinning agents used are petroleum, spirit, naptha and turpentine oil—Turpentine is used extensively because of high solvent power, excellent flattening properties and ideal rate of evaporation

Paints, Constituents

Drier:

- Driers are added to paints to quicken the drying of vehicles. Linseed oil dries by absorbing oxygen and it could be expedited by adding substances rich in oxygen. Some of the commonly used driers are as follows:
- **Litharge.**It is the most commonly used drier. It is especially used for lead paints but is not used for finishing coats.
- **Red lead.**It is less powerful than litharge and is used only when it does not affect the tint.
- **Lead acetate.**When ground in oil it is used for lighter tints.
- **Manganese dioxide.**It gives quick effect but can be used only for deep tints because of its darker colour.
- **Zinc sulphate.**It is more costly and is never used in paints with lead base.

Paints, Constituents

- Driers should not be used unnecessarily as they have a tendency to destroy the elasticity and cause flaking of the paint. Drier should not be used in a paint that dries well. Not more than one drier should be used at a time and it should be added to the paint just before the paint is to be used.
- **Inert filler:**
- It is an adulterant mixed to replace the base in part and thus reducing the cost of paint. Commonly used fillers are silica, charcoal, powdered chalk, aluminium silicate and barium sulphate etc.

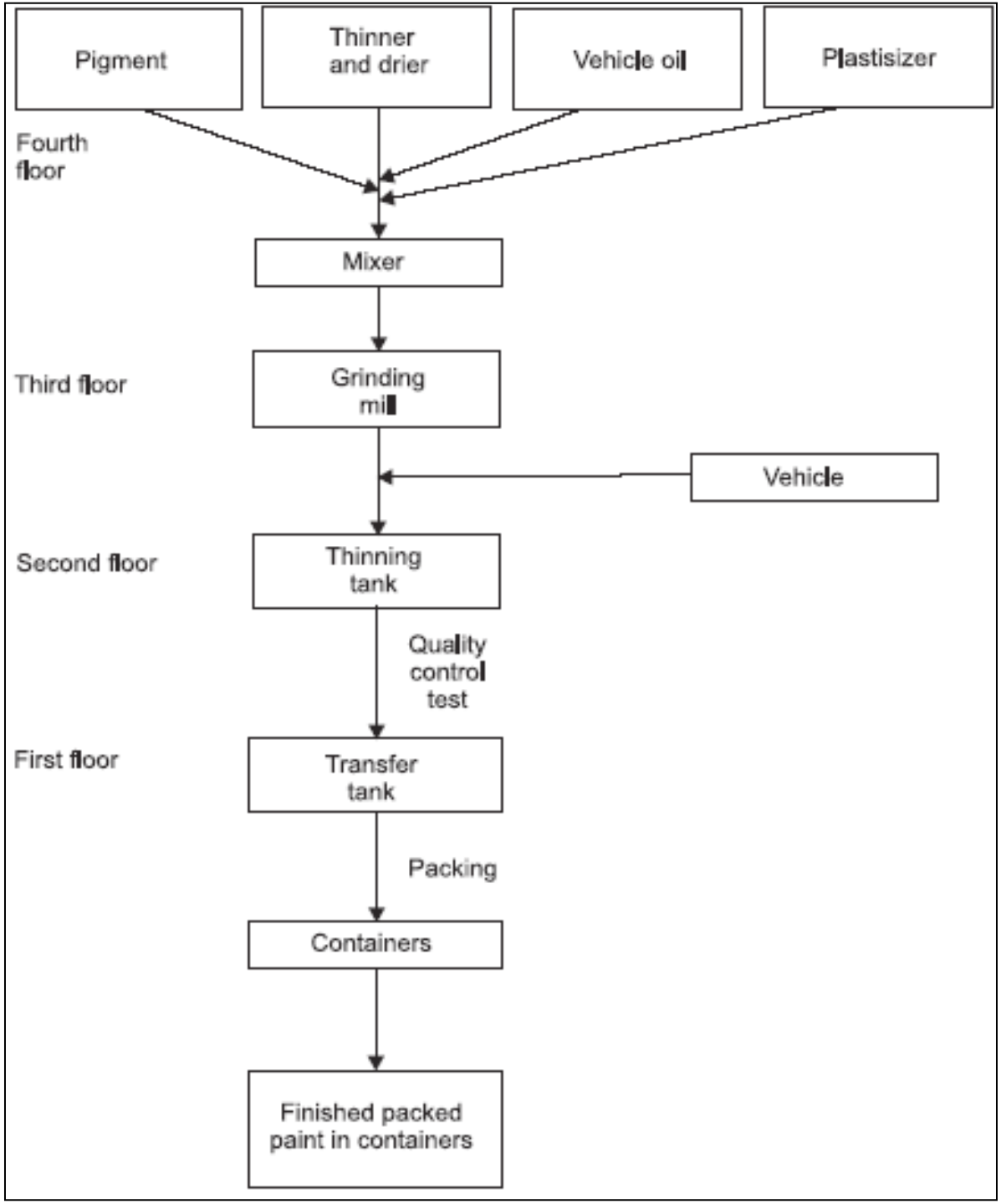
Paints, preparation

PREPARATION OF OIL PAINTS: The base (white lead) is thoroughly ground in oil and then mixed with the thinner (oil of turpentine) so as to give necessary workability to the paint. The pigment and the drier (if desired) are separately ground in linseed oil and mixed with turpentine oil to make it thin and then intimately mixed with the base that has already been prepared. The paint is then strained through fine cloth or sieve after which it is ready for use.

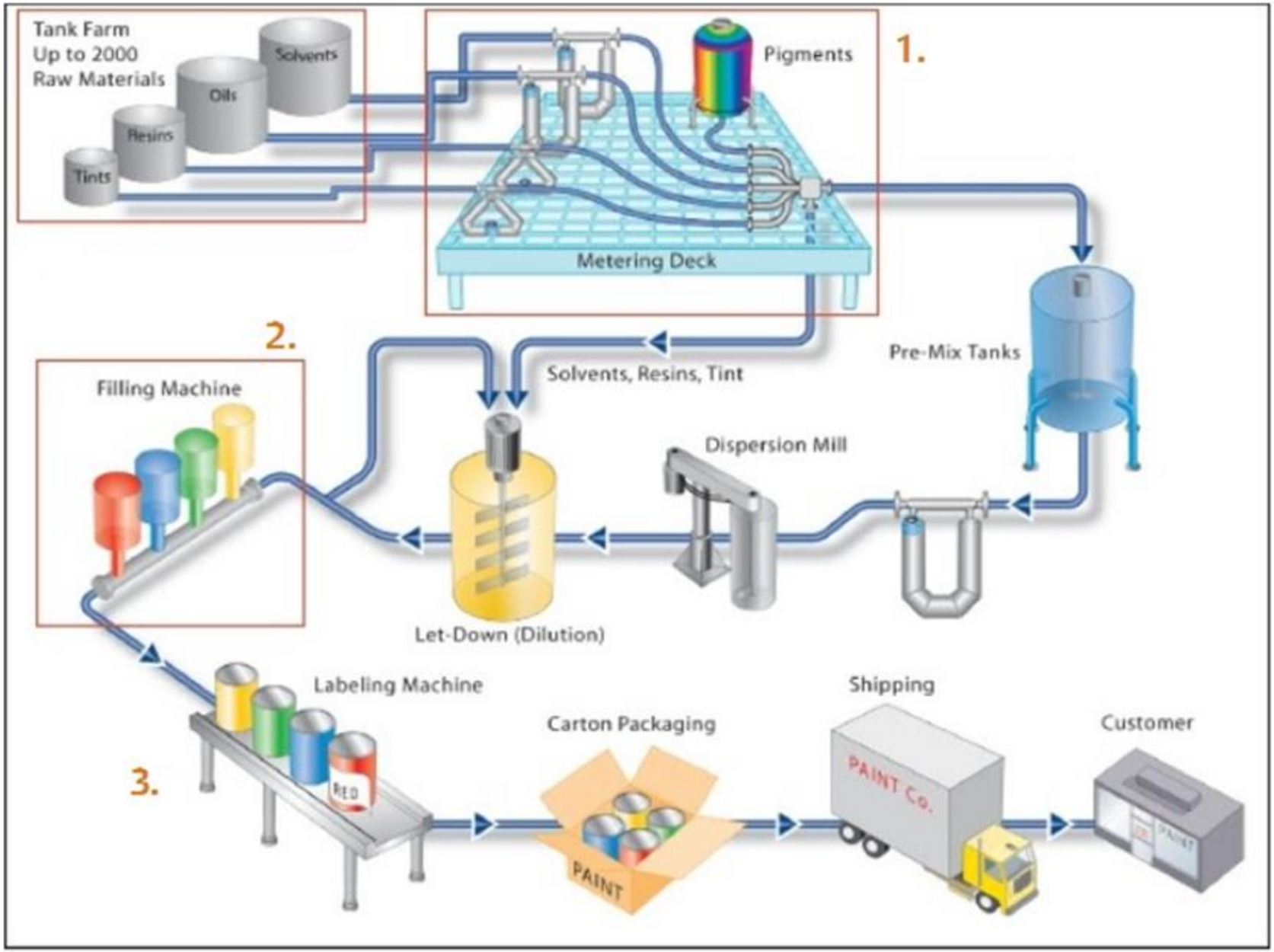
REMOVAL OF OLD PAINT: One of the following two methods could be employed to remove old paint froma surface:

- Burning the paint by directing the flame of a blow lamp on the painted surface and scrapping it. This method is quite suitable, quick and economical in case of iron or steel work but only expert workmen could be depended upon for its use in case of wood work. A little carelessness could leave the wood charred.

Paints, manufacturing flow diagram



Paints, manufacturing



Removal of old Paints

- Applying any one of the following paint removers:

- Hot solution of equal parts of soap, potash and quicklime is applied on the surface and kept on it for 24 hours, after which washing with hot water will remove the paint.
- Two parts of quicklime and one part of washing soda mixed with water to the consistency of cream spread on painted surface is kept for an hour. It is then washed off with clean water to remove the paint.
- Solution of caustic soda in water is applied to the surface. While applying caustic soda solution to the surface care should be taken of the hands. On wooden surfaces this solution should not be left long otherwise fibers of wood would be damaged.

Removal of old Paints

- The surface should be washed well with clean water and neutralized by applying a week solution of acid or vinegar.
  - Naptha is coated repeatedly on-the painted surface till the paint becomes soft. Then it is rubbed down and the surface cleaned.

Surface application

PAINTING PLASTERED SURFACE, Painting New Surfaces

- **Surface Preparation**: Paint cannot take care of construction defects. Before applying the paint it is ensured that the surface is free from dust, dirt, loose matter, grease etc. and is rubbed with a sand paper, to provide a mechanical key between surface and paint for satisfactory adhesion.
- **Sequence of Painting:** The primer (first coat) is applied with brush or spray on the prepared surface. It should be thinned with water or thinner in the recommended manner and proportion before application. After drying it is rubbed with emery paper.
- Dents and cracks, if any, are filled with putty using a knife applicator. Putty (paste from chalk etc) should not be applied thick. If the required thickness is large, it should be applied in two coats.

Surface application

After the putty has dried, the whole surface is rubbed down well in order to smoothen the putty and provide a mechanical key to the finished coats.

- Two or three finish coats are applied. Each coat is allowed to dry before the application of next coat.
- **Painting Old Surfaces**
- The procedure depends on the state of the existing coating. If any of the defects discussed below is very much pronounced it is completely removed and the surface is painted as a new surface.
- **Chalking:** Clean the surface; rub with an emery paper so that the chalk is removed. Apply one or two finish coats.
- **Efflorescence, Blistering, Cracking and Flaking:** Scrap off the old paint from affected areas. Touch up with primer and apply one or two finish coats on effected areas. Rub the entiresurface and apply the finish coats.

Surface application

- **Glossy Surface:** Remove all gloss by rubbing with emery paper and then apply the finish coats.
- **Fungus Growth:** Remove the fungus. Apply fungicidal solution liberally and observe for further growth. If no further growth of fungus is observed apply the desired paint.

PAINTING WOOD SURFACES: New Wood Work

- **Surface Preparation:** The wood should be well seasoned, dried, cleaned and the surface made smooth with an emery paper. Nails, if any, should be driven down the surface by at least3 mm.
- **Knotting:** Knots in the wood create lot of problems. These excrete resin which causes defects such as cracking, peeling and brown decolouration. Painting of Knot is done so that resin cannot excrete from the knots. Any of the following methods may be used suitably.

Surface application(wood)

Ordinary Knotting: This is also known as size knotting. The knot is treated with a coat of hot red lead ground with a strong glue size in water. Then a coat of red lead ground in boiled linseed oil is applied.

Lime Knotting: The knot is covered with hot lime for 24 hours after which it is scrapped off. Thereafter, the process described in ordinary knotting is followed.

Patent Knotting: Two coats of varnish or shelac are applied.

Priming Coat: The main function of priming coat or primer is to form the base for subsequent ones. After knotting, priming coat is applied over the entire surface to fill all the pores. A second priming coat is applied after first has dried. In general the ingredients are same as those of the subsequent coats but with a difference in proportion.

Surface application (on metal)

New Iron Work:

The surface should be free from scales, rust and grease. Scales and rust are cleaned by hardwire brush. Grease is removed by using petroleum or by hot alkaline solution of Na_2CO_3 orNaOH, benzene, and limewater. A priming coat of red lead with barytes ($BaSO_4$) and raw linseed oilis then applied over the prepared surface. After drying of the priming coat, one or moreundercoats with desired paint are applied. The second coat is given only after the first coathas dried. The finishing coat is applied carefully to produce a smooth fine surface.

Old Iron Work

The surface is prepared by scraping properly all the scales and rust with emery paper. Thegreasy substances are removed with lime water. The old paint may be burned with a blowlamp or by suitable solvents. After this the surface is brushed with hot linseed oil and paintedas for new iron work.

Defects in painting

Cracking: Cracks extending throughout the thickness of paint are caused by improper seasoning of painted wood, excessive use of drier or application of too many coats resulting in an excessive thickness of paint. It results in scaling of paint.

Crazing and crocodiling. Use of too much oil, use of impure oil and insufficient drying of undercoat may cause hair cracks in top coat. If these hair cracks enclose small areas then the defect is known as crazing, however, if the areas enclosed are large then the defect is known a crocodiling.

Blistering and peeling. Exposure of paints, rich in oil, to strong sunshine causes blisters. Blisters are also caused if oil or grease is left on surface to be painted. Painting a surface with moisture present on surface or in pores of wood causes peeling.

Runs and sage. Application of too thick or slow drying paint, painting over a glossy surface, use of excessive drier or excessive humidity and change of temperatures during drying period is the usual causes of the defect.

Defects in painting

Chalking. Use of insufficient oil in priming coat causes the paint to rub off with hands or clothes (the defect being known as chalking).

Washing off. Use of pigments soluble in water causes the deposit of dissolved matter at lower edges forming streaks.

Dull appearance. It is caused by use of excessive drier or on the paint becoming old.

Slow drying. Use of inferior or old oils, painting over damp surfaces or during unfavourable weather conditions causes this defect.

Yellowing of white paint. For indoor paintings where gloss is desired white enamel should be used otherwise minimum linseed oil, which has a yellow tint and does not bleach unless exposed to sun-shine should be used.

Enamels

Enamels consist of bases like zinc oxide, etc. ground in varnish. Desired colouring pigments may be added to get the desired tint. They dry slowly leaving a hard tough and elastic film which is smooth and durable. Enamel painted surfaces are washable and are not affected by acids, alkalies, gases or steam. These can be made in any tint which are usually delicate and decent . Even though they are more costly than ordinary paints yet, because of their durability, they ultimately prove to be more economical due to being long lasting and showing more resistance capacity against weathering effect . They are equally good for use both on external and internal works.

Water wash or Color wash (White wash):

Preparation of wash materail:

Fresh lime slaked with water is mixed thoroughly with water in a tub and then screened through a fine, clean cloth. Thereafter glue, is added to it by dissolving it in water, .

White wash

After it the surface is cleaned and the white wash is applied with jute brushes. A white wash when mixed with colouring pigment such as yellow earth is called colour wash.

Preparation of surface:

Surface to be white washed should be clean, smooth and dry. In case of re-white washing, the surface should be thoroughly cleaned and cleared of all foreign matter. Loose white wash should be scrapped. All holes, depressions etc should be made fair and smooth by removing the scratch-able material and applying repairs before application of white wash. Nail holes and patches caused by the removal of old white wash scales should be made good with lime putty. Greasy and smoky spots should be cleaned. All new patches should be given an extra coat of white wash after they have dried before commencing regular white wash.

White wash

Application: The wash will be laid on the surface with a moonj brush made quite soft. A vertical stroke followed by a horizontal stroke shall constitute one coat. Each coat must be allowed to dry before the next one is applied.

On new surfaces or where scrapping has been done, three coats of white wash would normally suffice.

One coat of white wash would suffice on a surface having the old wash in good condition. If the colour wash is to be replaced by white wash, then the old colour wash must be scrapped and three coats of white wash be applied.

A properly applied white wash should, when complete, form an opaque white coat with a smooth and regular surface through which the plaster or the old work does not show. It should present uniform white colour and should not readily come off on the hand when rubbed.

White wash

Characteristics

Lime is toxic for germs, for which white wash is good from hygiene considerations.

A bright surface is provided at a very low cost.

Uses: They are generally recommended for low and medium class houses; ceilings are whitewashed and walls are generally colour washed.

Distempers

These are paints used for the treatment of masonry walls. In them water instead of oil is used as a carrier. These are known as water paints too.

Distemper is made with base as white chalk and thinner as water. Some colouring pigments and glue are added. They are available in powder and paste forms and are substantially cheaper than paints. In market, a number of proprietary distempers are available. All prepared distempers are mixed with water only before being used.

As the distemper is affected by weather and comes off, if washed, so its use is restricted only to interior works preferably. It forms a cheap, durable and easy finish for interiors.

Distempers give a good finish but are likely to flake when subjected to alternate wetting and drying. These should be applied in dry weather after the surface has been cleaned and dried.

Varnish

Varnish is a solution of resin in either oil of turpentine or alcohol. It dries after applying leaving a hard, transparent and a glossy film of resin over the varnished surface.

Application:

Varnish is applied to the surface to increase its brilliance and to protect it from the atmospheric action.

It is applied to the un-painted wooden surface with a view to brighten the ornamental appearance of the grains of wood.

Composition:

The ingredients of varnish are: Resins, Solvents and Driers.

Resins: Commonly used resins are copal (resin from number of trees, used to make varnish) mastic, amber gum and lac. Quality of varnish depends much upon the quality of resin used. Copal is considered to be the best, toughest, hardest and is very durable for external work.

Varnish

1. *Resins or resinous substances*

The quality of varnish depends largely on the type of resin used. Various types of resins in use are copal, lac or shellac, resin, amber,mastic, gum dammer etc. Copal is a hard and lustrous resin obtained from ground where pine tree existed in past. Resin is obtained from pine trees. Lac or shellac is obtained by exudation of some insects which grow on some type of trees in India. Raw copal, an inferior type, is obtained from standing pine trees :

2. *Solvents*

Different types of solvents are available, but each is used only in conjunction with some specific resin. The following table gives the solvents for different resins :

Type of solvent	*Type of resin*
1. Boiled linseed oil	Amber, copal
2. Methylated sprit of wine	Lac or shellac
3. Turpentine	Mastic, gum dammer, rosin
4. Wood naphtha	Raw copal and other cheap varieties of resin.

Varnish

Characteristics of a good varnish

A good varnish should possess the following characteristics

1. It should dry quickly.
2. The protective film obtained on drying should be hard, tough, durable and resistant-to wear.
3. The finished surface should be uniform in nature and pleasing in appearance.
4. It should exhibit a glossy surface.
5. It should not shrink or show cracks on drying. It should have sufficient elasticity.
6. The colour of Varnish should not fade a way with time.

Ingradients of varnish

A varnish has the following essential ingradients :

(*i*) Resins or resinous substances.

(*ii*) Solvents.

(*iii*) Driers.

Varnish

Solvents: These must suit the resin used. Boiled linseed oil is used to dissolve copal or amber; turpentine oil for common resin or mastic; methylated spiritfor lac. Wood naptha (crude methyl alcohol) because of its offensive smell is not suited for superior works, and is used only for cheap varnish.

Driers: These should be added only in small quantities as the excess injures varnish and impairs its durability. Litharge or lead acetate is the commonly used driers in varnish, added to accelerate drying process.

Qualities of a Good Varnish

It should dry quickly.

On drying it should form a hard, tough and durable film.

It should have good weathering properties, resist abrasion and wear well.

It should be able to retain its colour and shine.

It should be uniform and pleasant looking on drying.

Varnish

Varnishing:

Varnish is applied as under:

Preparation of surface: The wood work is made smooth by rubbing it with sand paper and the surface is cleaned.

Knotting: It is the process of covering the knots in the wood work, using any of the following methods.

Size Knotting: A coat of red lead ground in water mixed with glue is applied. After it dries, another coat of red lead ground in oil and thinned by boiled turpentine oil is applied.

Patent Knotting: Two coats of varnish prepared by dissolving shellac in methylated sprit are used.

Stopping: The surface of the wood work is then rubbed again and cleaned. Before rubbing, the surface is applied with size of hot, weak glue.

Varnish Coat: Varnish is then applied in two coats. The second coat is applied after the first has dried.

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