PAINTS

PAINT

- Paint is any liquid, liquefiable, or mastic composition which after application to a substrate in a thin layer is converted to an opaque solid film.
- Paint is used to **protect, preserve, decorate**, or add **functionality** to an object or surface by covering it with a pigmented coating.
- An example of protection **is to retard corrosion of metal**. An example of decoration is to add festive trim to a room's interior.

- Despite the fact that there are many different types of house paint, most fall into one of two categories: **oil and water**. Oil based house paint is referred to as ***alkyd***, while water based house paint is commonly called latex or **acrylic** . The main differences between the two are their drying processes, their finishes, and the ease or difficulty of clean up. Oil based house paint takes longer to dry than the water based variety, but it contains additives to help speed up the drying process. Oil paints also create a harder, glossier finish, and require paint thinner or other chemicals for clean up. Water based paints, on the other hand, dry quickly as moisture evaporates. Their finish is not as shiny or as durable, but the ease of clean up makes water based paints a popular choice. They can be cleaned up with warm water and a bit of mild detergent.

- An example of added functionality is to modify light reflection or heat radiation of a surface. Another example of functionality is the use **of colour to identify hazard**s or to identify the function of equipment and pipelines.
- Paint can be applied to almost any kind of object. It is used, among many other uses, in the production of art, in industrial coating, as a driving aid (road surface marking), or as a barrier to prevent corrosion or water damage.

- Paint is a semi finished product, or intermediate good as the final product is the painted article itself.
- Paint can also be mixed with glaze to create various textures and patterns. This process is referred to as **faux finish** and is quite popular with discerning homeowners, architects and interior designers.
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Composition of Coatings

Most coatings have four basic types of ingredients:

- **Pigment**
- **Binder**
- **Vehicle or solvent**
- **Additives**

Pigments

- Pigments are **granular solids** incorporated into the paint to contribute **colour, toughness** or simply to reduce the cost of the paint. Alternatively, some paints contain dyes instead of or in combination with pigments. Other paints contain no pigment at all.

- Pigments can be classified as either **natural or synthetic types**.

- **Natural pigments** include various **clays**, calcium carbanate , mica, silicas, and talcs.

- **Synthetic pigments** would include engineered molecules, calcined clays, , precipitated calcium carbonate, and synthetic silicas.

- Hiding pigments, in making paint opaque, also protect the substrate from the harmful effects of ultraviolet light

Fillers

- **Fillers** are a special type of pigment **that serve to thicken the film**, support its structure and simply increase the volume of the paint.
- Fillers are usually comprised of **cheap and inert materials**, such as talc, lime, baryte, clay, etc.
- Floor paints that will be subjected to abrasion may even contain fine quartz sand as a filler.
- **Not all paints** include fillers.
- On the other hand some paints contain very large proportions of pigment/filler and binder..
- Some pigments are toxic, such as the **lead pigments** that are used in lead paint. Paint manufacturers began replacing white lead pigments with the less toxic substitute, which can even be used to colour food, titanium

Binder

- The binder, or resin, is the actual film forming component of paint.
- It is the only component that **must be present**; other components listed below are included optionally, depending on the desired properties of the cured film.
- The binder imparts **adhesion, binds the pigments together,** and strongly influences such properties as
  - **gloss potential,**
  - **exterior durability,**
  - **flexibility,**
  - **and toughness**.
- Binders include synthetic or natural resins such as acrylics, polyurethanes, polyesters, melamine resins,

- Binders can be categorized according to drying, or **curing mechanism**. The four most common are simple solvent evaporation, oxidative crosslinking, catalyzed polymerization, and coalescence. There are others.
- Note that drying and curing are two different processes. Drying generally refers to **evaporation** of vehicle, whereas curing refers to **polymerization** of the binder. Depending on chemistry and composition, any particular paint may undergo either, or both processes. Thus, there are paints that dry only, those that dry then cure, and those that do not depend on drying for curing.
- Paints that dry by simple solvent evaporation contain a solid binder dissolved in a solvent; this forms a solid film when the solvent evaporates, and the film can re-dissolve in the solvent again.

- Latex paint is a water-based dispersion of sub-micrometre polymer particles. The term "latex" in the context of paint simply means an aqueous dispersion; latex rubber **(the sap of the rubber tree** that has historically been called latex) is not an ingredient. These dispersions are prepared by emulsion polymerization.
- Latex paints cure by a process called **coalescence** where first the water, and then the trace, or coalescing, solvent, evaporate and draw together and soften the latex binder particles and fuse them together into irreversibly bound networked structures, so that the paint will not redissolve in the solvent/water that originally carried it.

- Paints that cure by oxidative **crosslinking** are generally single package coatings that when applied, the exposure to oxygen in the air starts a process that crosslinks and polymerizes the binder component. Classic alkyd enamels would fall into this category.
- Paints that cure by **catalyzed polymerization** are generally two package coatings that polymerize by way of a chemical reaction initiated by mixing resin and hardener, and which cure by forming a hard plastic structure. Depending on composition they may need to dry first, by evaporation of solvent. Classic two package epoxies or polyurethanes would fall into this category.

- Still other films are formed by cooling of the binder. For example, encaustic or wax paints are liquid when warm, and harden upon cooling. In many cases, they will resoften or liquify if reheated.
- Recent environmental requirements restrict the use of Volatile Organic Compounds (VOCs, and alternative means of curing have been developed, particularly for industrial purposes. In UV curing paints, the solvent is evaporated first, and hardening is then initiated by ultraviolet light.
- In powder coatings there is little or no solvent, and flow and cure **are produced by heating** of the substrate after application of the dry powder.

Vehicle or solvent

- The main purpose of the vehicle is to adjust the viscosity of the paint. It is volatile and does not become part of the paint film. It can also control flow and application properties, and affect the stability of the paint while in liquid state. Its main function is as the carrier for the non volatile components. Volatile substances impart their properties temporarily—once the solvent has evaporated or disintegrated, the remaining paint is fixed to the surface.
- What is viscosity? - In everyday terms (and for fluids only), viscosity is "thickness".

  Thus, water is "thin", having a lower viscosity, while honey is "thick" having a higher viscosity.

- **Water** is the main **vehicle** for water-based paints.
- Solvent-based, sometimes called oil-based, paints can have various combinations of solvents as the vehicle, including aliphatics, aromatics, alcohols, and ketones.
- These include organic solvents such as petroleu distillate, esters, glycol ethers, and the like.
- Sometimes volatile low-molecular weight synthetic resins also serve as diluents. Such solvents are used when water resistance, grease resistance, or similar properties are desired.

Additives

- Besides the three main categories of ingredients, paint can have a wide variety of miscellaneous additives, which are usually added in very small amounts and yet give a very significant effect on the product. Some examples include additives to
  - **Modify surface tension,**
  - **Improve flow properties,**
  - **Improve the finished appearance,**
  - **Increase wet edge,**
  - Improve pigment stability,
  - Impart antifreeze properties,
  - Control foaming,
  - Control skinning, etc.
  - Other types of additives include catalysts, thickeners, stabilizers, emulsifiers, texturizers, adhesion promoters, UV stabilizers, flatteners (de-glossing agents), biocides to fight bacterial growth, and the like.

Semi – Gloss Enamels

- These do not have much film former but a higher percentage of pigmentation than gloss enamels. The pigment particles are designed to project through the surface to diffuse the light refraction to achieve a lower sheen

  Paints comes in a variety of finish gloss levels. These are not standardized, but normally run:

  - **flat**
  - **matte**
  - **eggshell**
  - **satin**
  - **semi-gloss**
  - **high gloss**

- Different manufacturers group these differently, so some consider flat and matte to be synonymous, and so on.

- Manufacturers describe finish by percent gloss, where 0% gloss is a dull unreflective surface and 100% gloss is mirror-like.
- Values for percent gloss vary, as do the terms. For example, one manufacturer lists the values as such:

  - Flat (1-9% gloss)
  - Low Sheen (10-25% gloss)
  - Eggshell (26-40% gloss)
  - Semi Gloss (41-69% gloss)
  - Gloss (70-89% gloss)

Relative durability of finishes:

- Since the material they use to create gloss is dense and glassy, a gloss paint will be more **resistant to damage than a flat paint.**

Ease of cleaning:

- Glossy surfaces do not trap dirt like flat finishes, and generally are easier to clean. High-gloss paint is also more resistant to **staining.**

Ease of repair/touchup:

- Flat can be **touched up** locally without repainting the entire surface.

Other considerations:

- Prep time for high gloss surfaces is considerably more than for flat.
- The gloss finish will reveal **surface imperfections** such as sanding marks and fingerprints. In the automotive and marine industry, this is a major consideration.
- In traditional household interiors, walls are usually painted in flat or eggshell gloss, wooden trim (including doors and window sash) in high gloss, and ceilings almost invariably in flat. Similarly, exterior trim is usually painted with a gloss paint, while the body of the house is painted in a lower gloss.

- **Acrylic paint** is fast-drying paint containing pigment suspended in an acrylic polymer emulsion.
- Acrylic paints can be **diluted** with water, but become water-resistant when dry.

- **Enamel paint** is used to describe **oil-based covering products**, usually with a significant amount of gloss in them, however recently many latex or water-based paints have adopted the term as well.
- The term today means "hard surfaced paint" and usually is in reference to paint brands of higher quality, floor coatings of a high gloss finish, or spray paints.

Sealers , Primers and Undercoats

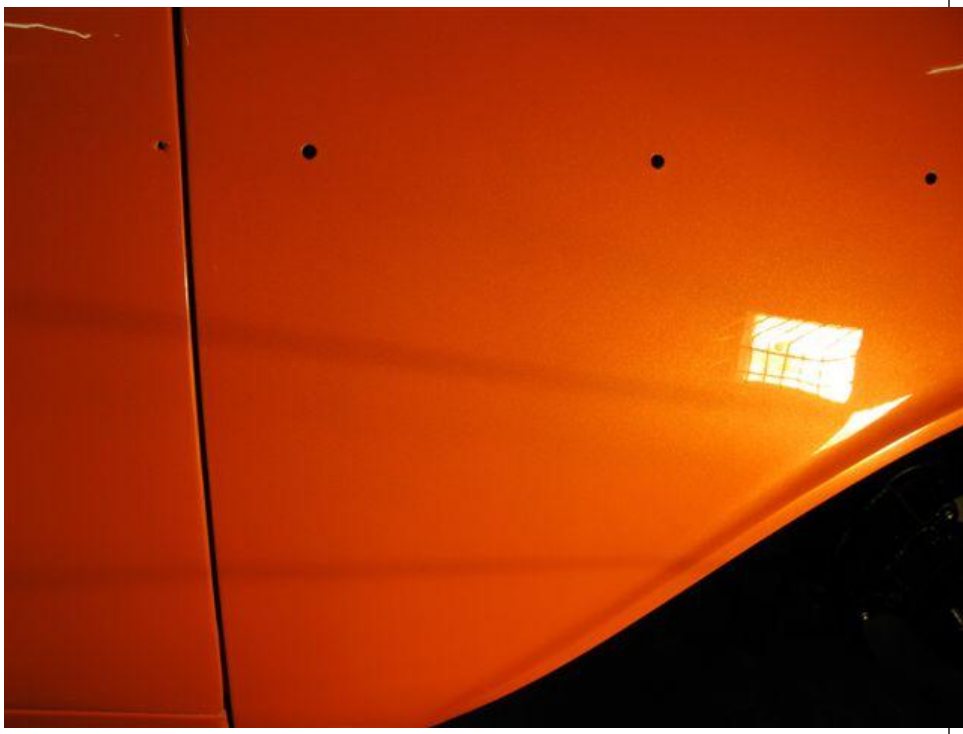
- These are paints used to prepare the surface for painting. The sealer is used to seal the surface to minimise porosity while the primer is used to facilitate both **adhesion and ease of application** of the top coat.
- The term undercoat is often confused with the primer coat although the two are quite different. The undercoat is used to cover the primer or sealer and act as the base colour for the coats of paint.

Color changing paint

- Various technologies exist for making paints that change color.

Thermochromic paints

- **Thermochromic** paints and coatings contain materials that change conformation when heat is applied, and so they change color.
- Liquid crystals have been used in such paints, such as in the **thermometer strips** and tapes used in fishtanks.
- Recently car manufactures have been testing



Photochromic paints

- **Photochromic** paints and coatings contain dyes that change conformation when the film is exposed to UV light, and so they change color.
- These materials are used to make **eyeglasses**.

Electrochromic paints

- **Electrochromic** paints change color in response to an applied electric current. Car manufacturer Nissan has been reportedly working on an electrochromic paint for use in its vehicles, based on particles of paramagnetic iron oxide.
- See pic opposite

- **Electrochromic** paints can be applied to **plastic substrates** as well, using a different coating chemistry.
- The technology involves using special dyes that change conformation when an electric current is applied across the film itself.
- Recently, this new technology has been used to achieve glare protection at the touch of a button in passenger airplane windows.

Common Paint Film Problems/Defects

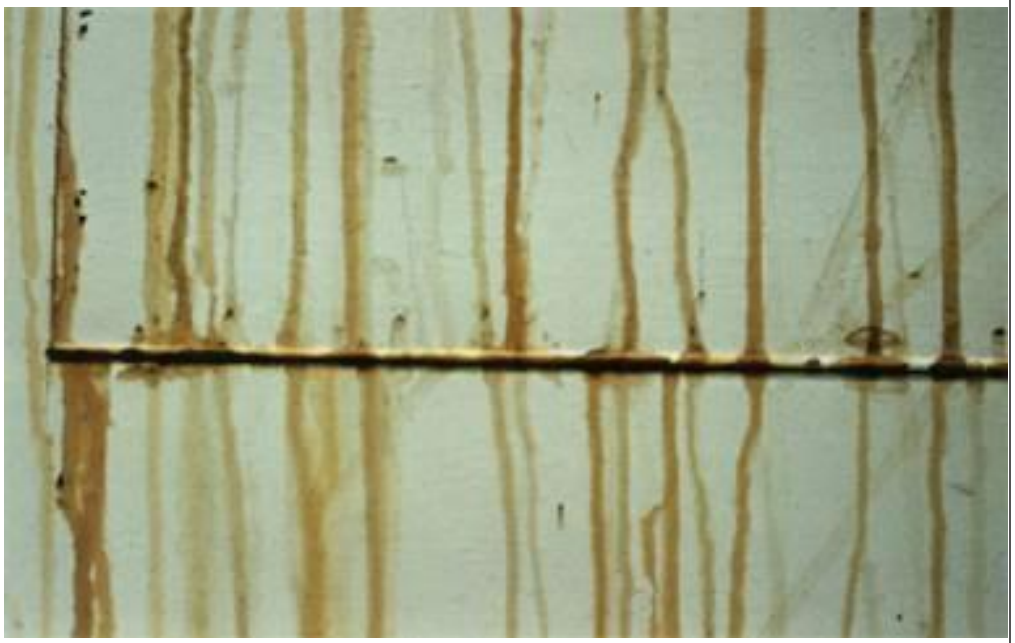
- **Mildew** – occurs in moist humid conditions (bathrooms, kitchens, laundry rooms) when using alkyd or oil based paint or lower quality paint. Can occur due to failure to **prime wood** before painting and not successfully removing mildew from the surface before repainting

Cracking and Peeling

- -occurs if the paint had inadequate adhesion and flexibility, overspreading or thinning of the paint, inadequate surface preparation or applying to bare wood without primer, and hardening and fragility as the paint ages.

Bleeding

- -Discolouration of paint film due to pigment seeping to the surface from undercoats or gum from knots in timber.



Blistering

- -formation of small areas of **swelling** on the surface caused by painting in the direct heat of the sun or from trapped moisture, seeping through to the surface or from corrosion sites.

Chalking

- -appearance of **fine powder** on the paint film due to weathering causing the resin to break down, or painting over a porous surface.

Cissing

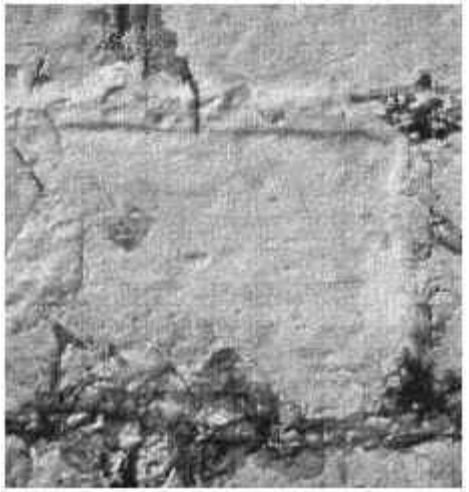
- **Shrinkage or contraction** of the new coating away from area which is contaminated by grease, oil or polish (particularly silicone types.)

Crazing

- - irregular cracking of surface film due to age application of the paint over an oily or wet undercoat.

Efflorescence

- - formation of a series of **open blisters** in a paint film due to soluble salts rising to the surface from brick, plaster and cement objects.



Flaking

- - occurs when the paint peels away from the surface due to a crack or joint in the film. It may be caused by use of an unsuitable undercoat, or shrinkage/ expansion of the surface.

Sagging

- Formation of a **waterfall – like** appearance on the surface due to , too much paint being applie in one coat.