PAINTS, ITS CONSTITUENTS & FUNCTION
OBJECTIVES

To:

• Understand the:
  – Definition & properties of paint
  – constituents of paint, their properties & functions
Definition:

“Paint is defined as a unique homogeneous mixture of three major ingredients namely Binder, Pigment, VOC & additives, which when applied on the surface as a thin layer that forms a solid dry adherent film after oxidation/evaporation/polymerisation”.

• In the broadest terms, a paint consists of a particular pigment, dispersed in a particular binder, dissolved in a particular solvent
• In general the corrosion protection afforded by a paint film is ∞ to its DFT measured by Elcometer—an electro-magnetic induction gauge

*Adhesion: the degree of attachment between film & the substrate
Properties:

• It should have high hiding power & the required colour
• It should be able to resist the atmospheric conditions to which it will be put
• The films produced should be washable
• It should resist corrosion
• It should have the necessary consistency (property to resist permanent change of shape) for a particular purpose for which the paint is to be used
• The film produced by applying the paint on a surface should have gloss

*All the requirements can be obtained in a paint by properly choosing the proper pigments, extenders, binders and their quantities. There is no set methods for doing so.
PURPOSE OF PAINT

Purpose:

• To avoid loss of metal due to corrosion
  – Protects the metal surfaces from the corrosive effects of weather (sun, wind, rain, frost, atmospheric pollution & other natural elements), heat, moisture, gases etc.

• Delays in rusting

• Provides:
  – aesthetic look to materials
  – a smooth surface for easy cleaning
CONSTITUENTS OF PAINT

Paints are variable combinations of :-

– Binder
– Pigment
– Filler/ Extender
– Volatile organic compound (Thinner)
– Driers
– Additives (Anti skinning agents, Anti settling agent, Plasticizers, fire retardants etc)
BINDER

“Binders are usually resins or oils but can be inorganic compounds”

• The actual film forming component & absolutely required ingredient of any paint”
• Consists of a resin and a solvent thinner
• It is the part which solidifies to form the dry paint film when the solvent evaporates
• Non-volatile & mainly polymers of various types. They are alkyd, epoxy, polyurethane resins etc
• Different resins form dry film on the substrate in different manners
  • Alkyd resins (widely used binders) form dry film simply by volatilization as well as by oxidation in presence of air
  • Epoxy & PU resin mainly dry through chemical reactions
**BINDER**

- **Purpose:**
  - Binds pigment, fillers & additives together
  - Imparts adhesion & strongly influences:
    - Gloss
    - Durability
    - Flexibility
    - Toughness

**Binders include resins:**
- Alkyds, Polyurethanes (PU), Epoxy, Polyesters
PIGMENTS

“Pigments are finely ground inorganic or organic powders of higher RI (> 1.5)

– Higher the RI, more the light is bent & greater the opacity

– Good opacity has good lighting absorbing & /or scattering properties

– Average diameter ranges from 0.01 to 5μ
PROPERTIES OF PIGMENT

• Should be opaque so that it may have good covering power.
  – When a coating is opaque the pigment particles scatter &/or absorb light sufficiently to prevent it from reaching the substrate
  – Opacity depends on two characteristic properties:
    • Refractive Index (RI)
      – If the particles do not have a high RI, less the bending of light travelling & thus insufficient hiding of the substrate.
    • Particle size:
      – Particle size has also an effect on the effectiveness of the pigment. As the particle size decreases, opacifying ability increases.

• Should be non-toxic so that they have no bad effect on health of painter & inhabitants
Purpose:

Pigment plays a major role to attain the following essential properties of paint system

– provides colour, opacity, film cohesion and sometimes corrosion inhibition
– provides aesthetic look to the paint
– obliterates the substrate and previous colour on the substrate, if any
– protects the film by reflecting the destructive UV light
PIGMENTS

Widely used pigments:
White Lead, Zinc Oxide, Titanium Dioxide, Red Oxide, Carbon Black, Prussian Blue, Chrome Yellow, Aluminium powder etc.

* [Titanium dioxide is extensively used because it has good covering power).
Titanium is an excellent reflector of infrared].
EXTENDER/FILLER

Non-expensive commonly natural inorganic materials added to the paint in order to increase its volume. (RI <1.5)

• Extenders are mainly inorganic substances & do not provide colour to the paint but added to improve adhesion, ease of sanding and film strength

• As they are cheap in comparison to prime pigments, they reduce overall cost of the paints

• Average dia: up to 50µ
EXTENDER/FILLER

Properties:
• Do not provide colour
• Poor optical properties (reflectance, opacity, etc)
• It improves adhesion
• If extender pigment added are of needle shaped or flaked shape, the settling may be very little

Purpose:
– thickens the film
– Increases volume, paint film thickness
– reduces cost of the paint
– imparts toughness, abrasion resistance & texture
– Control consistency

Widely used fillers:-
– Calcium carbonate, Gypsum, Ground silica, Barytes, Slate powder, French chalk, china clay, asbestos, silica, mica, whiting etc.
VOC/THINNER

“Liquid used for viscosity adjustment for correct application”

• Used to dissolve the binder and to facilitate application of paint. Solvents are
  • usually organic liquids or water.
  • not a part of the paint film.
  • Excessive thinner dulls the colour & gloss
  • Most hazardous due to its toxicity & flammability
  • Once the solvent gets evaporated, the remaining paint is fixed on to the surface

Purpose:-

• Control flow and application properties
• Act as carrier for binders & pigments
• Help penetration into porous surfaces
• Used to clean brushes & other painting tools
Widely used thinner:

• Turpentine oil (distilled pine tree sap): the most commonly used thinner
• Benzene & Naphtha: as substitute.
• Mineral spirit, acetone, carbon tetra chloride, ethyl alcohol
**DRIERS**

- Depending upon the nature of the solvent and film thickness, the drying process may take as long as several hours.
  - Thicker the film, longer the drying time. If the drying process is artificially accelerated, there may be problems with adhesion between the protective film and the metal surface.

- Metallic salts of Lead, Manganese, Cobalt, etc. of organic acids
  - Easily soluble at ordinary temp
  - Added in small quantity
  - One drier should be used at a time
  - Added to the paint just before use.

**Purpose:**
- to accelerate the drying process.

**Examples:**
- Lead acetate, Cobalt octate, Manganese octate, Litharge, Red lead, Lead octate, Manganese dioxide, Zinc sulphate, etc.
CORROSION INHIBITOR

“A compound which prevents corrosion by forming a metal oxide layer”

• The surface becomes passivated.

Purpose:-

• To protect the substrate from corrosion

Commonly used corrosion inhibitors:

• Sodium molybdate
• Zinc molybdate
"Additives are small amounts of different chemical substances improving or modifying the paint properties.

- Added to a paint in amounts 0.001% & \( \leq 5\% \) & have a profound influence on physical & chemical properties of the paint
- Prevent clustering of pigments
- Surfactants such as polyoxyethylene ethers of dodecyl alcohol, e.g. \( \text{C}_{12}\text{H}_{25}\text{O} (\text{CH}_2. \text{CH}_2.\text{O})_6\text{H} \) is added to attain compatibility of different material in the paint system
ADDITIVES

- **Driers** accelerate the paints drying (hardening) by catalyzing the oxidation of the binder.

- **Plasticisers** (liquids of mol wt higher than that of solids to limit volatility) increase the paints flexibility, durability, compatibility & minimise film cracking.

- **Fungicides, Biocides and Insecticides** prevent growth and attack of fungi, bacteria and insects. (protect the paint in storage from spoilage due to bacterial growth)

- **Flow control agents** improve flow properties.

- **Defoamers** prevent formation of air bubbles entrapped in the coatings.

- **Emulsifiers** are wetting agents increasing the colloidal stability of the paints in liquid state.
ADDITIVES

- **UV stabilizers** provide stability of the paints under ultra-violet light.
- **Anti-skinning agents** prevent formation of a skin in the can.
- **Adhesion promoters** improve the adhesion of the coating to the substrate.
- **Corrosion inhibitors** reduce the corrosion rate of the substrate.
- **Texturizers** impart textures to the coatings.
- Antifreezers helps to withstand exposure
- Pigment stabilizers improve pigment stability
- Fire retardant properties
- Anti settling
Thank You
Have a nice day!