

COMPOSITION OF PAINTS

A paint is formulated as a mixture of four ingredients:

- ☐ **Binder**
- ☐ **Solvent**
- ☐ **Pigment**
- ☐ **Additives**

Binders of paints

Binder is the main ingredient of paints. Binders are polymers (resins) forming a continuous film on the substrate surface.

Binders are responsible for good adhesion of the coating to the substrate. The binder holds the pigment particles distributed throughout the coating. The binder is dispersed in a carrier (water or organic solvent either in molecular form (true solutions) or as colloidal dispersions (emulsions or sols)).

Common binders are as follows:

- ☐ **Alkyd resins** are prepared by the condensation polymerization in the reaction of fatty acid and polyols (commonly glycerol) with polybasic acids.
- ☐ **Acrylic resins** are prepared by polymerization of acrylic or methacrylic esters.
- ☐ **Latex (PVA)** is a vinyl polymer prepared by free radical vinyl polymerization of the monomer vinyl acetate.
- ☐ **Phenolic resins** are thermosetting polymers prepared by the reaction of simple phenol with aldehydes (eg. formaldehyde).
- ☐ **Urethane resins (polyurethanes)** are prepared by the step-growth polymerization of isocyanates reacting with monomer molecules containing hydroxyl (alcohol) groups.
- ☐ **Epoxy resins** is a thermosetting polymer formed as a result of cross-linking a resin containing short molecules in the presence of a hardener.
- ☐ **Chlorinated rubber** is prepared through polymerization of the degraded natural rubber (in the presence of atoms of chlorine participating in cross-linking).

Solvents of paints

Solvent (water or organic solvent) is a medium where the binder, pigment and additives are dispersed in molecular form (true solutions) or as colloidal dispersions (emulsions or sols).

Solvents (thinners) are also used for modification of the paint viscosity required for the application methods: brush, roller, dip, spray.

The solid coating is formed due to evaporation of solvent therefore the evaporation rate is one of the important properties of solvents. Other important properties are the ability to dissolve the paint ingredients and toxicity.

The solvents used as the carrier in paints:

- ☐ **Water**
- ☐ **White spirits (mineral turpentine spirits).** White spirit is a mixture of saturated aliphatic and alicyclic hydrocarbons.
- ☐ **Xylene** is a pure aromatic solvent having benzene ring structure in its molecule (C_8H_{10}).
- ☐ **Toluene** is also a pure aromatic solvent with benzene ring structure ($C_6H_5CH_3$).
- ☐ **Alcohols (n-butanol, isopropanol)** are organic compounds having a hydroxyl groups (-OH) bound to the carbon atoms of an alkyl group.
- ☐ **Ketones** is an organic solvents, in which carbonyl group ($C=O$) is bonded to two other carbon atoms.

Pigments of paints

Pigment is a solid substance dispersed throughout the coating to impart it a color, opacity (hide the substrate surface).

Pigments may protect the substrate from UV light.

Pigments change the paint appearance (gloss level) and properties: increase hardness and decrease ductility. Pigments may be natural, synthetic, inorganic or organic.

Fillers and extenders are also referred to pigments. **Fillers and extenders** are non-expensive commonly natural inorganic materials added to the paint in order to increase its volume, to increase the paint film thickness, to impart toughness or abrasion resistance to the coating.

Pigments commonly used in paints:

- ☐ **Titanium Dioxide (TiO_2)** is a white synthetic inorganic pigment existing in two crystalline forms: rutile and anatase. Titanium dioxide has high refractive index (anatase 2.52, rutile 2.76). Anatase is photochemically active but provides clear white color therefore its main application is interior paints. Photochemically inert rutile is used for protection of paints from degradation by light. Titanium oxide is the most widely used pigment.
- ☐ **Zinc Oxide (ZnO)** is a white synthetic inorganic pigment having refractive index 2.01.
- ☐ **Zinc Yellow (Yellow 36)** is Zinc Chromate ($ZnCrO_4$).
- ☐ **Yellow Dyes** are stable yellow non-toxic organic pigments with good opacity.
- ☐ **Benzidine Yellows** are yellow-to-red organic pigments for interior applications. They are resistant in chemicals and stable at elevated temperatures (up to $300^\circ F$ / $150^\circ C$).
- ☐ **Chrome Oxide Green** is olive-green inorganic pigment with a high level of opacity. Chrome Oxide Green is the most stable green pigment.

- ☐ **Phthalocyanine Green** imparts green-blue color. It is used as the pigment for decorative applications. The pigment is resistant to heat, solvents and alkalis.
- ☐ **Phthalocyanine Blues** are widely spread pigments. They provides a wide spectrum of color: from reddish-blue to yellowish-green. The pigments are non-toxic and resistant to solvents, chemicals and elevated temperatures.
- ☐ **Ultramarine Blue** is natural pigment made of the semiprecious mineral lapislazuri. The pigment is resistant to fading. It is stable at elevated temperatures.
- ☐ **Vermilion** is a natural orangish red pigment consisting of toxic mercuric sulfide (HgS).
- ☐ **Pigment Brown 6** is red inorganic pigment based on Iron(III) oxide (Fe_2O_3).
- ☐ **Red 170** is a synthetic organic pigment widely used in automotive industry.
- ☐ **Dioxazine Violet** is organic synthetic pigment. It is non-toxic and has high tinting strength.
- ☐ **Carbon Black** is the pigment obtained from organic materials (wood, bones) by charring (thermal decomposition in a limited amount of Oxygen). large quantities of Carbon Black are used for coloring and reinforcing automobile tires.
- ☐ **Iron (II) Oxide (FeO)** is inorganic black pigment.

Examples of fillers and extenders:

- ☐ **Quartz sand (SiO_2)**. Finely ground quartz is a filler increasing the abrasion resistance of the paints.
- ☐ **Talc** having the lamellar structure serves as a reinforcing phase in the coating. Talc also protects the substrate from the penetrating water.
- ☐ **Baryte (BaSO_4)** is a colorless or white inorganic mineral having high hardness and chemical resistance. It is used as a reinforcing additive.
- ☐ **Kaoline Clay** is a natural colloid containing finely dispersed particles of hydrated aluminum silicate. Kaoline Clay is used in emulsion paints as a gloss reducing additive.
- ☐ **Limestone** (calcium carbonate, CaCO_3) is used in emulsion paints as a filler extending expensive pigments.

Additives for paints

Additives are small amounts of substances modifying the paint properties.

Examples of additives:

- ☐ **Driers** accelerate the paints drying (hardening) by catalyzing the oxidation of the binder.
- ☐ **Plasticisers** increase the paints flexibility.
- ☐ **Fungicides, Biocides and Insecticides** prevent growth and attack of fungi, bacteria and insects.
- ☐ **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.

- ▣ **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.

Source : http://www.substech.com/dokuwiki/doku.php?id=composition_of_paints