PAINT

(Part-I)

INDUSTRIAL CHEMISTRY

B.SC 3RD YEAR HONOURS

(STUDY MATERIAL)

What is Paint?

Paints are stable mechanical mixture of one or more pigments. The main function of pigments is to impart the desired colour and to protect the film from penetrating radiation such as UV rays.

Constituent of Paints

1. Pigments: These are insoluble organic or inorganic substances. Important properties of good pigments include: opacity, good covering power, good mixing ability with oil, chemical inertness, non-toxicity, high hiding power, high tinning strength and reasonable cost. The function of paint is to protect the film to be paint from destructive UV radiation and to strengthen the film.

Examples various pigment used for painting:

White: TiO_2, ZnO; **Red**: Pb_3O_4, Fe_2O_3; **Blue**: Ultramarine blue, cobalt blue; **Green**: Cr_2O_3, phthalocyanine green; **Yellow**: $ZnCrO_4$, $PbCrO_4$, litharge; **Black:** Carbon black, lamp back; **Orange**: basic lead cromate, cadmium orange; **Brown**: burnt umber; Metallic: Cu powder, Zn dust, Al; Metal protective pigments: Pb_3O_4, blue lead.

2. Extenders or Fillers: These are added to paint in order to decrease the cost of the paint by increase the volume of paint and serve to thicken the film. Fillers are usually inert and cheap. e.g. talc, gypsum, silica, china clay.

3. Film forming materials or Vehicle: The vehicle or film forming materials serve as a dual purpose in the surface coating formulation. They act as carriers of the pigments and forms protective films. Reactive oils having high degree of olefinic unsaturation are used as vehicles or film forming materials. Depending upon the unsaturation they are usually two types drying oils and semidrying oils. These oils form a protective film by oxidation and polymerisation reaction of the unsaturation constituents of the drying oil. e.g. of drying oils are linseed oil, caster oil and semidrying oils are coconut oil, tobacco seed oil.

4. Driers: These are oxygen carriers have been used in the paints in order to accelerate drying of the film through oxidation and polymerisation. The unsaturated drying oils polymerises by a reaction mechanism which involves peroxide intermediate. The drier act as a catalyst and promotes oxidation and polymerisation process. e.g PbO, Co, Mn, Zn e.t.c. They dissolve in the hot oil and reduces the drying time. To rapid drying is not desirable because of some unwanted effects such as surface wrinkling.

5. Thinners or diluents: These are added to the paint in order to dissolve film forming material and to thin the concentrated films for better handling and also used to suspend pigments. After adding thinner the paint may be applied more easily on the surface by brushing and spraying. e.g. Aliphatic nor aromatic hydrocarbon, terpentine, pine oil e.t.c. Lacquer is another type of thinner or diluents which employ aliphatic chemicals such as ethers, esters, ketones, alcohols to provide desired volatility.

6. **Antiskinning agent**: These are added to the paint in order to prevent gelling and skinning of the finished product before application of the paint by brushing. e.g. Polyhydroxy phenol.

7. **Plasticizers:** These are added to reduce the cracking of paints by providing elasticity to the film. Plasticizers are low melting solid or low volatile liquids. e.g. Ester compounds, triphenyl phosphate, dibutyl phthalate, castor oil.

8. **Resins:** Resins are required for oil based paints and not for water based paints. Varnishes are used as natural or synthetic resins. Other natural resins are copal, rosin while that of synthetic resins are urea formaldehyde, acrylate, vinyl or silicon resin.

9. **Binder:** Binders act to fix the paint on the coated surface and provide tough, tenacious and glossy film on the surface being painted. Binders may be of the following types

(a) **Oxidising resins**: Used for house paint, interior paints

(b) **Cellulose resins**: Used for making low temperature backing under coats

(c) **Silicon resins:** Used for superior chemical and heat resistant coats

(d) **Phenoplast resins:** Used for thermosetting under coats

(e) **Polyesters:** Used for making resistant of the glossy films from discolouration

(f) **Acrylonitrile copolymer and butadiene copolymer**: Used for making emulsion paint, fire & corrosion resistant coats.

10. **Extenders:** These are added to the paint mixture in order to prevent the cracking of the film during drying. e.g. Clay, talc, barytes.

11. **Other compounds:** Dispersing agents (e.g. Casein); antifoam agents (e.g. pine oil); preservative (e.g. chlorophenol).

MANUFACTURE OF PAINT

Paint is manufactured in a four storied floor chambers as shown in the flow diagram

4th Floor (Top floor): Here pigments, drying oils, thinner and plasticizers are weighted, assembled and mixed.

3rd Floor: The mixing of pigments and vehicles is done in a mixer in 3rd floor called dough kneader with sigma blades. The batch mass is transferred to the next cahmber below it. Grinding and further mixing takes place here by a steel ball mill.

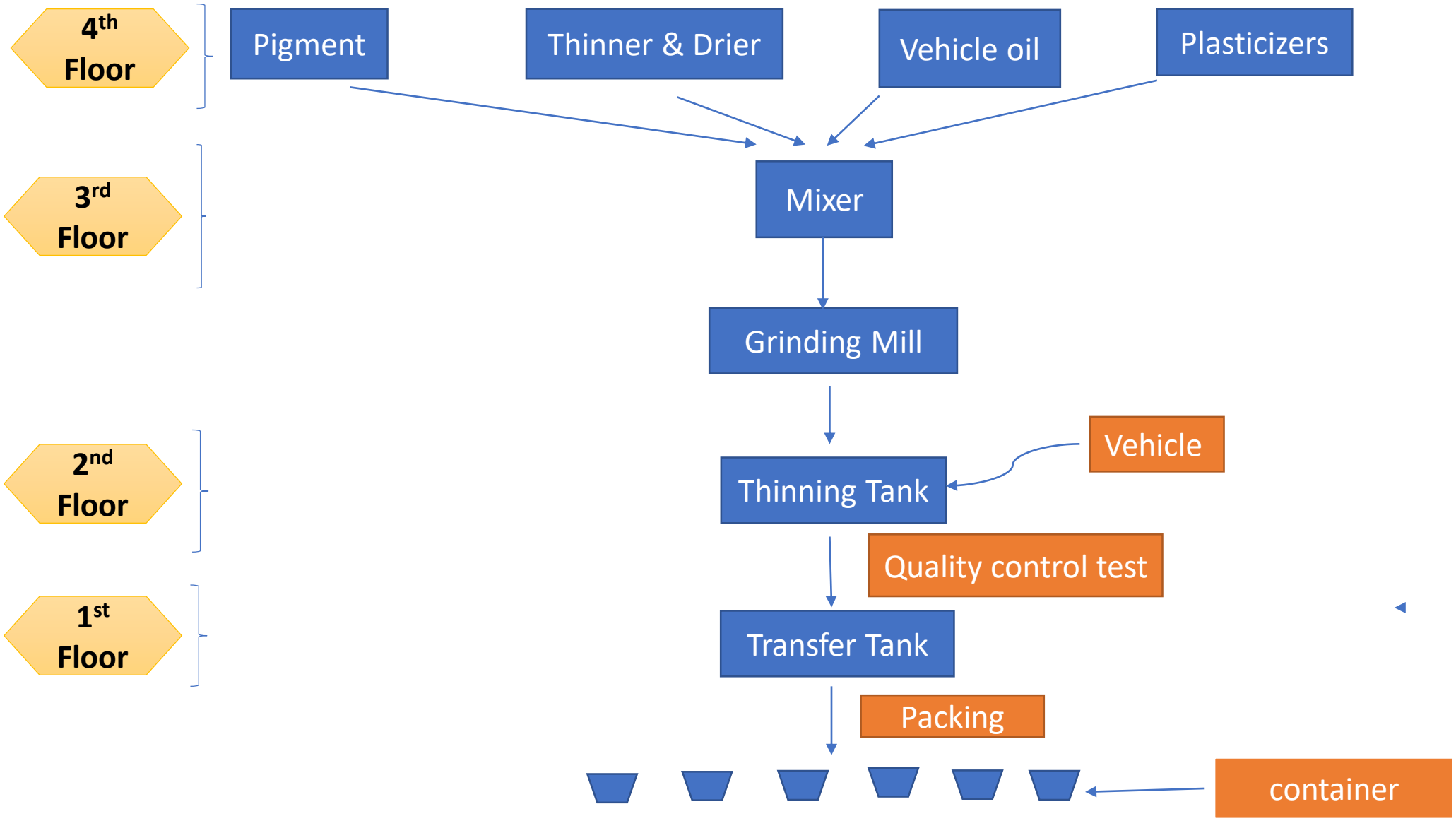
2nd Floor: After thorough mixing the resulting smooth mass is transferred here for further mixing with thinner and if necessary with tinting agent.

1st Floor: The finished liquid paint is then screened and passed into the hopper machine present in 1st floor.

Non dispersed pigments are removed by making use of centrifuges, screens or pressure filters. The paint is poured into cans or drums, lebelled and packed All these procedures are automatic.

MANUFACTURE OF PAINT (Flow diagram)

Paint is manufactured in a four storied chambers as shown in the flow diagram below



PAINT FALIURE

The paint failure occur due to destructive oxidation of the oil after drying of the paint on surface. Progressive powdering of the paint (called chalking) may be the cause of paint failure. Sometimes when dirt, grease or water molecules enter into paint and there become a poor attachment of paint on the surface resulting paint failure. This is called flaking or peeling. Alligatoring is another type of paint failure when centre position of the paint is attached with the surface but the position around the centre not attached properly. Fine surface cracking is called as checking and is due to the absence of plasticizers in the paint.

Paint failures can be avoided by:

1. Careful mixing of the constituents or ingredients in specified proportion
2. Proper processing of the surface to be coated before the paint is applied
3. Using a primer coat before the application of the paint.

SETTING OF PAINT

The various steps for the setting of paint in a particular surface occur by following way with the help of different constituents of paint

- When the paint is applied on the surface of the metal or wood, the oil present in the paint forms a protective film of dried oil.
- The film is formed through oxidation and polymerisation reaction of the unsaturated constituents of the drying oil.
- The drier present in the paint accelerates the drying of the protective film through oxidation and polymerisation reaction and thus act as catalyst for those reactions.
- Pigment materials present in the paint strengthen the film and protect it by reflecting the destructive UV rays.
- Extenders increases the covering and weathering power of the pigments and thus improve the consistency, levelling and setting.
- Oils as plasticizers reduces the cracking aspects of paint.

REQUIREMENTS OF A GOOD PAINT

1. The pigments used in the paint should be opaque.
2. It should have good covering power.
3. It should be chemically inert.
4. It should have good colour.
5. It should have good hiding power.
6. It should be weather resistant.
7. It should have good washability.
8. It should have anti corrosive property.
9. It should have specific range of PVC value (Pigment Volume Concentration).

PVC = Volume of the pigment in the paint/(Volume of pigment in the paint + Volume of the non-volatile vehicle constituents in the paint)

Importance of PVC

1. The gloss decreases as the PVC increases. This is due to the fact that when volume of pigment increases relative to the non volatile vehicle, gloss decreases until the finish or gloss of the paint become flat.

2. With increase in PVC, both adhesion as well as durability both decrease. If volume of pigment increases as compared to the volume of binder, the film will loose cohesion. The paint will be in powdered form and obviously will have little durability.

3. When extenders are added, the PVC increases and gloss decreases. For common colour PVC range 50-75 %.

VARNISH

A varnish may be regarded as an unpigmented colloidal dispersion or solution of natural or synthetic or both resins in oils in absence of the thinners. They are used as protective or decorative coating for various surfaces. They dry on the surface by evaporation, oxidation and polymerisation of its constituents. It is 2 types.

1. **Spirit Varnishes:** These are solutions of natural reins such as rosin, copal, gum e.t.c., in methylated spirit or other volatile non film forming solvent. These varnishes dry more rapidly but undergo cracking and peeling.

2. **Oleoresinous Varnishes:** These are the solution of one or more natural or synthetic resins in a drying oil and a volatile solvent in addition some plasticizers. Urea formaldehyde, phenol formaldehyde resins are the synthetic that have been used for making these varnishes. Linseed oil, turpentine oil, castor oil are used as the solvent.