The manufacture and chemistry of paints have undergone profound changes since the 1940s. Nowadays paints, lacquers, and varnishes are complex mixtures of several components. The detailed composition of a paint, lacquer, or varnish is planned to meet the special requirements of its use, and also the expectations concerning health and safety requirements [9, 10, 40].

### 18.1 Paints

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#### 18.1.1 Composition

The paints can be liquids or powders that are applied to surfaces to make a dry coating for protective or decorative purposes. The protective functions include prevention of corrosion, resistance to fire, and protection against fungi, marine growth, and radiation. Reduction of friction, control of illumination, and electrical insulation are other functions that paints have. The basic constituents include pigments, film formers, solvents, and additives. Varnishes and lacquers have the same composition as paints, but do not contain pigments [9, 31, 40].

### 18.1.1.1 Pigments

Pigments are fine powders which give the paint its color. They also cover and hide surfaces. Limited solubility in water and in solvents as well as good color fastness are characteristic to pigments. They must also be dispersed in a paint formulation containing a resin binder to bind the pigment to the painted surface. Depending on the concentration of pigments and their particle sizes, paints can be classified as glosses (15%–20% pigments), flats (40%–45% pigments), and semiglosses between these two. Pigments also need to be opaque; if not, they can be used as extenders that may, for example, help to prevent pigment setting in the can and act as a matting aid [9, 31, 40].

The most commonly used white pigment is titanium dioxide, which can be used in combination with zinc oxide. Other white pigments include white lead, lithopone (which is a mixture of zinc sulfide and barium sulfate) and antimony trioxide. Red pigments include inorganic compounds such as synthetic iron oxides, red lead oxide, and cadmium red. Yellow pigments comprise chrome yellow (varying proportion of lead chromate, lead sulfate, lead monoxide), strontium yellow, nickel titanate yellow, zinc yellow, zinc chromate, or earthen iron oxide (ochre). Chrome orange, molybdate orange, lead molybdate, and cadmium mercury orange are examples of orange pigments. Chrome green and chromium oxide are examples of green pigments. Blue color is obtained with a certain iron oxide and violet color with manganese.
Carbon black is the most commonly used black pigment, but mineral black, bone black, graphite, and black iron oxide can also be used as black pigments [10, 15, 31, 40].

Organic pigments are used for special purposes. They are generally purer, but more expensive. Examples include Hansa yellow, Irgazin orange and violet, copper phthalocyanine green and blue, toluidine red, para red, lithol red and rhodamine red [10, 31].

Nowadays paint manufacturers usually supply only some oil-based or emulsion-type basement paints of which thousands of shades of color can be produced by adding a combination of pigment pastes according to a special shading chart [10].

18.1.1.2 Solvents

Solvent-based paints (SBPs) dominated the market for construction paints until the 1970s. The first water-based latex type paint was introduced in 1957 as an exterior paint (International Agency for Research of Cancer, 1989). Because of the health hazards to the peripheral and the central nervous system (World Health Organization 1985) connected with SBPs, they have gradually been replaced by water-based paints (WBPs) whenever possible. This has not been possible, for example, in a humid atmosphere because of the slow evaporation of water. During the past 10 years WBPs have constituted more than 90% of the construction paints in Scandinavia. In 1992, the use of SBPs among house painters was only 4% of the total paint consumption in Sweden [15, 34, 38, 40, 45, 47].

SBPs contain about 50% organic solvents. Solvent is the volatile component of a paint and is used to make consistency suitable for application in different ways (brushing, rolling, spraying, etc.) Up to the 1970s, turpentine was the most important solvent used in many countries in construction paints, but was later replaced by aliphatic hydrocarbon solvents. Solvents are chosen for their solvency, evaporation, and suitability for the use of the product. [31, 40, 45, 47].

Nowadays also coatings that are free from organic or other solvents are increasingly used. Powder paints are composed of pigments, binders and additives which are melted together, cool set, and ground into a powder that is applied by electrostatic spray. The film on the coated object is cured by heating. Powder paints can be used for the coating of new metal goods and small metal components [40].

18.1.1.3 Film Formers

Resins or binders are the film-forming agents in paints. The resin hardens and keeps the pigments bound and permanently dispersed on the painted surface. The binder dictates the most important properties of the paint, such as hardness, flexibility, and speed of drying. Examples of resins used in paints and coatings include the following [31, 40].

Naturally Drying Oils

Naturally drying oils including dammar, Japanese lacquer, and shellac are suitable for lacquers and varnishes because they dry quickly, although the film formed is brittle. Copal is a fossil resin that can be used in varnishes. Other natural oils such as flaxseed or linseed, perilla, tung oils, pine oil or tall oil, soybean, and ricinus oils have been used in oil-based paints. Since the 1980s synthetic alkyd resins have widely replaced naturally drying oils [10, 31].

Alkyls

Alkyls are condensation products of polyalcohols, e.g., glycerol, trimethylol propane pentaerythritol and polycarboxylic acids such as phthalic acid or its anhydride, adipic and maleic acid. Alkyd resins are formed by modifications with oils containing unsaturated fatty acids. These include linseed, soybean, sunflower, cottonseed, and tall or pine oil. Linseed oil and similar drying oils can be combined with colophony (rosin) to produce a paint resistant to climatic conditions that also has good color retention. Synthetic polyester alkyls contain no modifying oils. Styrene and vinyl toluene are used as cross-linking agents for these polymers. Epoxidized alkyd resins are alkyls modified with epoxidized oils, which are formed by reacting double bonds in unsaturated fatty drying oils with oxygen to form an epoxide ring. The paints based on these types of alkyd resins need no hardener