Shroff S.R. Rotary Institute of Chemical Technology (SRICT)

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2163604 (Technology of Pigments)

Introduction to Pigment

- **Introduction**

- Pigment means a substance consisting of small particles that is practically insoluble in the applied medium and is used on account of its coloring, protective, or magnetic properties.
- Both pigments and dyes are included in the general term "coloring materials", which denotes all materials used for their coloring properties.
- The characteristic that distinguishes pigments from soluble organic dyes is their low solubility in solvents and binders.
- Pigments can be characterized by their chemical composition, and by their optical or technical properties. In this introductory section, only inorganic pigments used as coloring materials are discussed.

- **Extenders (fillers)**

- Extenders (fillers) are substances in powder form that are practically insoluble in the medium in which they are applied.
- They are usually white or slightly colored, and are used on account of their physical or chemical properties.
- The distinction between an extender and a pigment lies in the purpose for which it is used.
- An extender is not a colorant, it is employed to modify the properties or increase the bulk (volume) of a given material.

- Dyes and pigments are coloring substances, i.e. substances imparting a specific color to the substance (substrate) being colored. Dyes, among which organic compounds predominate, dissolve in and fuse or react with the substrate being dyed.
- Pigments are insoluble and they color the substrate by coating its surface. Finely ground inorganic substances predominate among pigments.
- Dyes are organic compounds, which contain in their molecules color imparting chromophoric groups and acid or basic auxochromic groups responsible for dyeing ability due to the auxochromes, dye molecules can be permanently bonded with fibers or other materials).
- Pigments are coloring substances, which do not enter into chemical reactions with polymers and are insoluble in them. Depending on their chemical and crystalline structure and particle sizes, pigments can cause the surface reflection or absorption of light.

- Chemical engineering aspects of pigments and dyes synthesis made essential part in development applied in chemical technology operations and constructions of specialist apparatuses.
- Besides their traditional use in textile, leather, paper, as well as the paint and varnish industries, dyes and pigments have become indispensable in other fields such as microelectronics, medical diagnostics and information recording techniques and they continue to be intensively developed.
- Coloring agents are substances able to impart color to substrates. Traditionally, coloring agents have been divided into soluble dyes and insoluble pigments.
- Pigments have stable physical and chemical properties during dyeing, whereas both natural and physical dyes are soluble in water or organic solvents. Dyes are classified according to their chemical constitution or depending on the methods and fields of their application

- The chemical classification of dyes is primarily based on the presence of a chromophore, i.e. a chemical group which determines dyeing power.
- The principal dyes here are azo, anthraquinone, indigoid, arylmethane, and phthalocyanine dyes.
- Because of the large number of dyes used in the textile industry another classification of dyes and pigments is specific to this industry, which demands dyes in a wide range of fast colors and brilliant shades (harmless after dyeing).
- The dyeing process be simple and inexpensive and the dyed fabrics be resistant to: light, atmospheric changes, washing in a warm solution of soap and detergents, boiling, ironing, sweat, mechanical action, and the chemicals pre sent in domestic detergents.

- **Classification**
- **Classification of inorganic pigments.**
- **White pigments:** the optical effect is caused by nonselective light scattering (examples: titanium diox- ide and zinc sulfide pigments, lithopone, zinc white)
- **Colored pigments:** the optical effect is caused by selective light absorption and also to a large extent by selective light scattering (examples:iron oxide red and yellow, cadmium pigments, ultramarine pigments, chrome yellow, cobalt blue)
- **Black pigments**: the optical effect is caused by nonselective light absorption (examples: carbon black pigment, iron oxide black)
- **Effect pigments:** the optical effect is caused by regular reflection or interference

- **Metal effect pigment** Regular reflection takes place on mainly flat and parallel metallic pigments particles example: aluminum flakes)
- **Pearl luster pigment:** Regular reflection takes place on highly refractive parallel pigment platelets (example: titanium dioxide on mica)
- **Interference:** The optical effect of colored luster pigments is caused wholly or mainly by the phenomenon of interference (example: iron oxide on mica)
- **Luminescent Pigments :** The optical effect is caused by the capacity to absorb radiation and to emit it as light of a longer wavelength
- **Fluorescent :** The light of longer wavelength is emitted after excitation without a delay (example: silver-doped zinc sulfide)
- **Phosphorescent pigments:** The light of longer wavelength is emitted within several hours after excitation (example: copper-doped zinc sulfide)

- **General Chemical and Physical Properties**
- **Chemical Composition**
- Inorganic pigments are oxides, sulfides, oxide hydroxides, silicates, sulfates, or carbonates and normally consist of single- component particles (e.g., red iron oxide, α-Fe_2O_3 with well-defined crystal structures. However, mixed and substrate pigments consist of non-uniform or multicomponent particles.
- ***Mixed pigments*** are pigments that have been mixed or ground with pigments or extenders in the dry state (e.g., chrome green pigments are mixtures of chrome yellow and iron blue). If the components differ in particle size and shape, density, reactivity, or surface tension.
- In the case of *substrate pigments*, at least one additional component (pigment or extender) is deposited onto a substrate (pigment or extender), preferably by a wet method. Weak, medium, or strong attractive forces develop between these pigment components during drying or calcining. These forces prevent segregation of the components during use.n, they may segregate during use.

- Special substrate pigments include the after treated pigments and the core pigments. To produce *after treated pigments* the inorganic pigment particles are covered with a thin film of inorganic or organic substances to suppress undesirable properties (e.g., catalytic or photochemical reactivity) or to improve the dispersibility of the pigments and the hydrophilic or hydrophobic character of their surfaces.
- The particles can be coated by precipitation (e.g., after treated TiO_2 pigment), by adsorption of suitable substances from solutions (usually aqueous), or by steam hydrolysis.
- To produce *core pigments*, a pigment substance is deposited on an extender by precipitation or by wet mixing of the components. In the case of anticorrosive pigments, whose protective effect is located on their surfaces, the use of core pigments can bring about a significant saving of expensive material.
- Extender particles are also treated by fixing water-insoluble organic dyes on their surfaces via lake formation.

Classification of white and black pigments

Chemical class	White pigments	Black pigments
Oxides	Titanium dioxide	iron oxide black
	zinc white, zinc oxide	iron-manganese black spinel black
Sulfides	zinc sulfide	
	lithopone	
Carbon and carbonates	white lead	carbon black

Classification of organic pigments.

- Yellow pigments

Family	Coloristic properties	Resistance properties
Anthraquinone	medium to high color strength, transparency	good heat, light and migration fastness, good to excellent weather to fastness
Diazo pigments	high color strength, wide range of shade and opacity	good heat, light and migration fastness, medium to good weathering
Isoindolinone	medium to high color, strength, greenish, reddish yellow, and orange	excellent heat, light and migration fastness, excellent weathering, particularly at low concentration and TiO_2 reduction
Mono Azo salts	medium color strength	good heat, light and migration fastness, low weathering

Orange pigments

Family	Coloristic properties	Resistance properties
Benzimidazolone	high saturation and opacity	good heat, light and migration fastness, medium weathering
Diketo pyrrolo pyrrole (DPP)	very pure and brilliant shade, high color strength, wide range of shade and opacity	good to excellent heat, light and migration fastness, reds show good to excellent weather resistance
Isoindolinone	medium to high color, strength, greenish, reddish yellow, and orange	excellent heat, light and migration fastness, excellent weathering, particularly at low concentration and TiO_2 reduction

Brown pigments

Family	Coloristic properties	Resistance properties
Diazo pigments	high color strength, wide range of shade and opacity	good heat, light and migration fastness, medium to good weathering

Red pigments

Family	Coloristic properties	Resistance properties
Anthraquinone	medium to high color strength, transparency	good heat, light and migration fastness, good to excellent weather to fastness
BONA Lake	high color strength, pure shade	low heat and light fastness, good migration
Diazo pigments	high color strength, wide range of shade and opacity	good heat, light and migration fastness, medium to good weathering
Diketo pyrrolo pyrrole (DPP)	very pure and brilliant shade, high color strength, wide range of shade and opacity	good to excellent heat, light and migration fastness, reds show good to excellent weather resistance
Naphthol Lake	high color strength, pure shade	good heat and migration fastness, low light fastness
Quinacridone	medium to high color, strength, bluish red and violet	good heat, light and migration fastness, good to excellent weathering, particularly in TiO_2 reduction

Blue pigments

Family	Coloristic properties	Resistance properties
Anthraquinone	medium to high color strength, transparency	good heat, light and migration fastness, good to excellent weather to fastness
Phthalocyanine	high color strength	good heat, light and migration fastness, good to excellent weathering

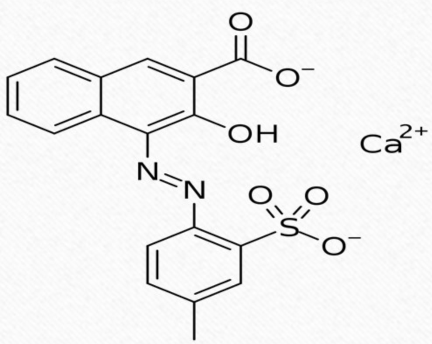
Violet pigments

Family	Coloristic properties	Resistance properties
Dioxazine	high color strength	good heat, light and migration fastness, medium weather
Quinacridone	medium to high color strength, bluish red and violet	good heat, light and migration fastness, good to excellent weathering, particularly in TiO_2 reduction

Green pigments

Family	Coloristic properties	Resistance properties
Phthalocyanine	high color strength	good heat, light and migration fastness, good to excellent weathering

- A lake pigment is a pigment made by precipitating a dye with an inert binder, or "mordant", usually a metallic salt. Unlike vermilion, ultramarine, and other pigments made from ground minerals, lake pigments are organic.
- Manufacturers and suppliers to artists and industry frequently omit the lake designation in the name. Many lake pigments are fugitive because the dyes involved are not lightfast.
- Red lakes were particularly important in Renaissance and Baroque paintings; they were often used as translucent glazes to portray the colors of rich fabrics and draperies



- A LAKE PIGMENT is an insoluble material that colours by dispersion.
- Lakes are basically a pigment which has been manufactured from a dye by precipitating a soluble dye with a metallic salt. The resulting pigment is called a lake pigment.
- Lakes are produced from the FD&C Dyes and are oil dispersible (but generally not oil soluble) and as such they can be mixed with oils, fats and sugars. They can also be dispersed in other carriers such as propylene glycol, glycerin and sucrose (water and sugar).
- Lakes are created in specific concentrations of the Dye which is used.
- As an example, Red 40 Aluminum Lake is available in Low Dye (generally 15-17% pure dye) and High Dye (36-42% pure dye).
- Lakes are generally preferred in several applications, including: **To color an oil based product**, such as balm base, chocolate or compound coatings.

- **COLOUR STABILITY:**
- Lakes are generally colour stable, meaning they resist bleeding.
- Dyes have a tendency to "bleed", or migrate from one part of the product to another. A red and white soap, may therefore become all pink int he future if dyes were used.
- Likewise with colour swirled lip balms or candy canes or any product where there are specific colour borders or stripes. In many cases Dyes can be used in confectionery production, Lakes will be substituted if bleeding is a problem.
- **Benefits of Lake Food Colors:**
- Lake food colors are highly adaptable and versatile: They can be dispersed in suspension of propylene glycol or sucrose.
- Lake colors are stable: Much more stable than water-soluble dye colors.
- Lake colors can be utilised to color many varieties of products and are commonly used in cosmetics and pharmaceuticals.
- Lakes are available in different concentrations of colors.
- Lake colors are oil soluble and can be mixed in vegetable oils, fats, other cosmetic oils etc.

- Toner is a powder mixture used in laser printers and photocopiers to form the printed text and images on the paper, in general through a toner cartridge.
- Mostly granulated plastic, early mixtures only added carbon powder and iron oxide, however mixtures have since been developed containing polypropylene, fumed silica, and various minerals for tribo-electrification.
- Toner using plant-derived plastic also exists as an alternative to petroleum plastic. Toner particles are melted by the heat of the fuser, and are thus bonded to the paper.
- Toner is made up mostly of finely ground **polyester**, which is a type of plastic. Like your slacks sticking to your legs, polyester powder can hold a static charge that grabs onto anything with an opposite charge.