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NAPIM Summer Course

Pigments for Ink Application

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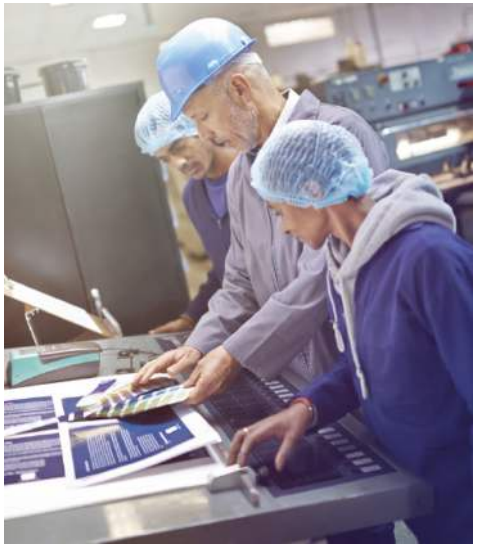
Agenda

- Brief Printing Overview/Ink Types
- What is color?
- Colorant Overview
- Final Thoughts
- Questions

What is printing?

- Process of applying color (or clear coating) onto a substrate
- Many different methods, each with advantages and disadvantages
- Choice based on end use and economics
  - Film thickness
  - Dry time/press speed
  - Set-up time
  - Run length
  - Print quality

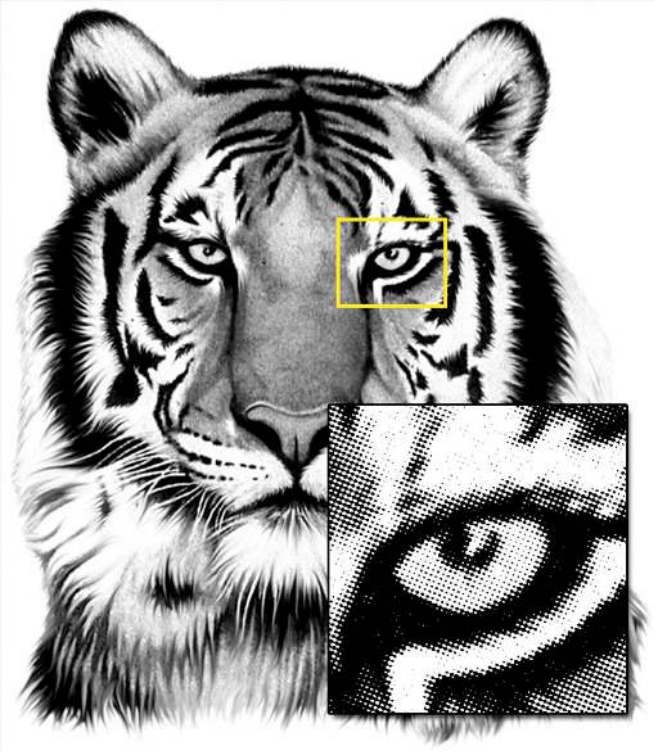


Line work

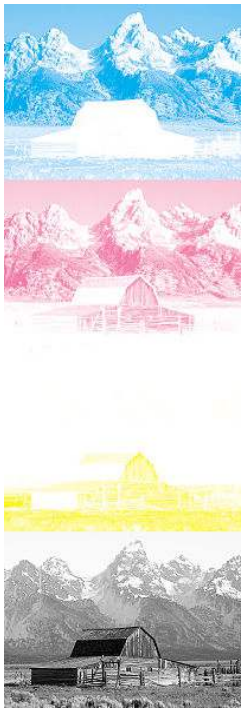
- Lines and solid blocks of spot colors

Image taken from www.greenlinepaper.com

Halftone dots



Process color



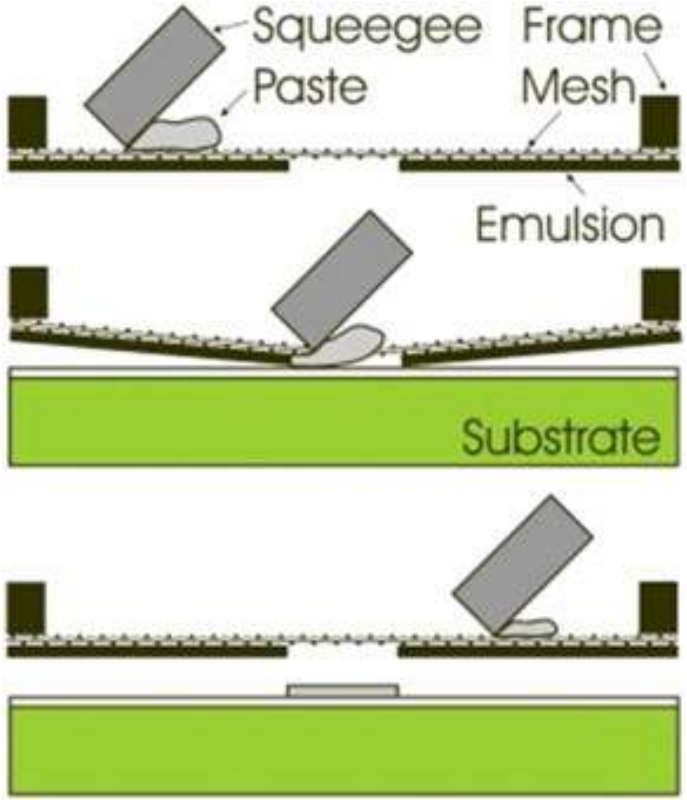
Some Common Printing Processes

- Screen
- Offset lithography
- Gravure
- Flexography
- Digital

Screen Printing

Screen printing – process

- Mesh (polyester or steel) is masked with a photocured emulsion
- Thick ink is pushed through mesh with squeegee



Screen printing – inks

- High viscosity, but shear thinning
- Thick films are slow drying (except energy cure)
- Can be waterbased, solventbased, or energy curable

Lithography

Lithography – process

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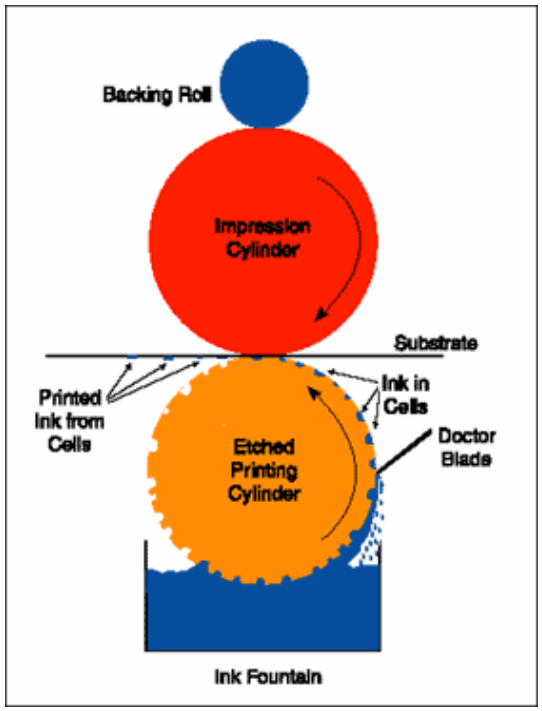
- Flat plate with photosensitive polymer is developed by light exposure or laser
  - Image area repels water, but accepts oily ink
- Plate is dampened with water, which goes to non-image areas (waterless process is also possible; but requires special plate)
- Ink is applied across plate, only sticks to image areas (ideally!)
- Plate is pressed to an offset roll (blanket cylinder), which transfers the image to the substrate

Lithography – ink properties

- Very high viscosity (paste)
- Controlled degree of tackiness, determines order of colors
- Two types of drying/curing
  - Oxidative drying of oils - slow
  - Energy cure - fast

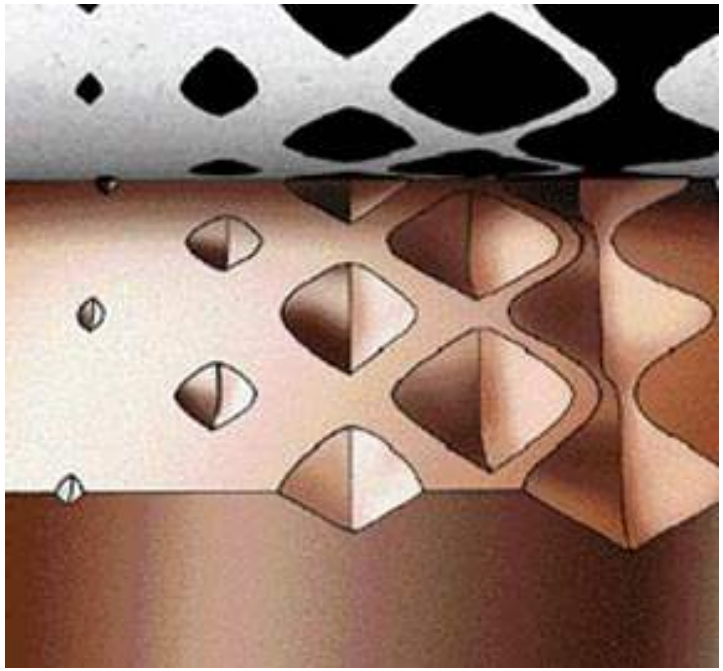
Gravure

Gravure – process



- Design is engraved into gravure cylinder
- Cylinder rotates through ink fountain
- Excess ink is scraped from surface by doctor blade
- Inked cylinder is pressed directly onto substrate

Gravure – engraved roll

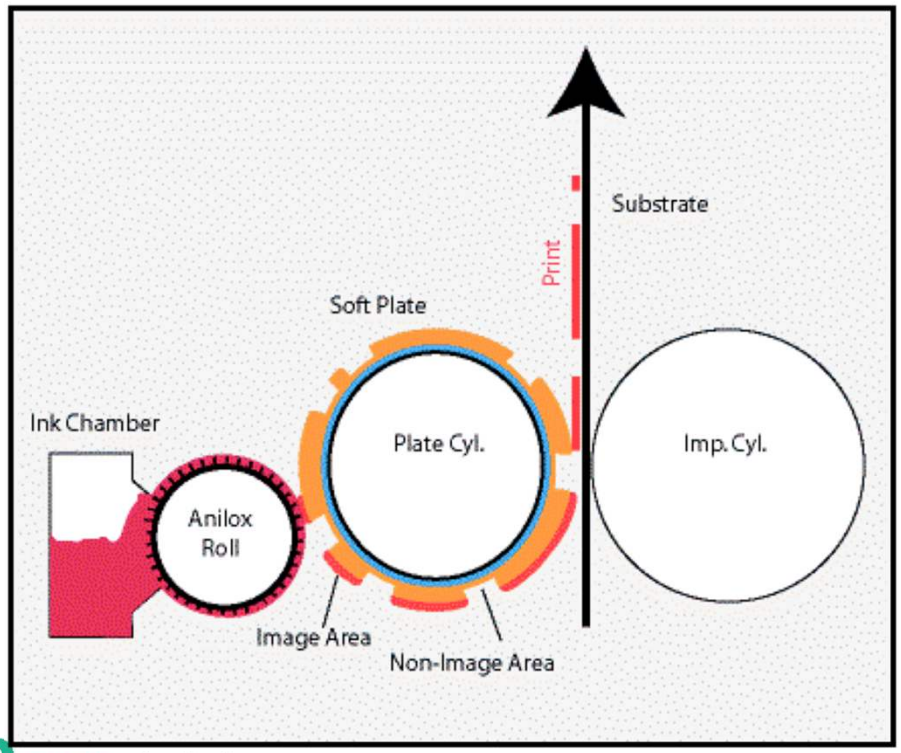


Gravure – ink properties

- Low viscosity
- Needs to be resoluble
- Needs to be fast drying
- Other ink properties determined by end use
- Solventbased, waterbased or energy curable

Flexography

Flexography – process



- Ink is picked up by an anilox roll, completely covered with etched cells of the same size
- Ink is transferred from anilox cells to raised print areas on flexo plate
- Plate transfers ink to substrate

Flexography – ink properties

- Low viscosity (but higher than gravure)
- Ink must be resoluble
- Must be fast drying
- Other properties dependent on final application
- Can be waterbased, solventbased, or energy curable

Resolubility – why it matters

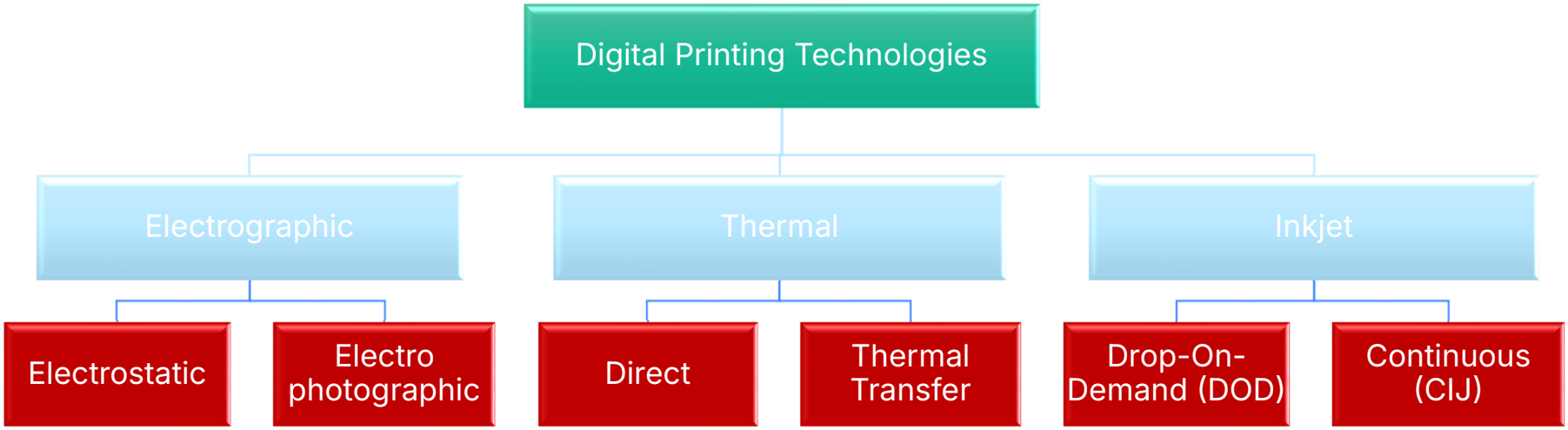
Dry Offset

Dry Offset

- Combination of Flexography and Offset
- Comparable in viscosity to lithographic inks (pastes)

Digital

Digital Printing Types: Overview



Drop-on-Demand Inkjet: Formulation Challenges

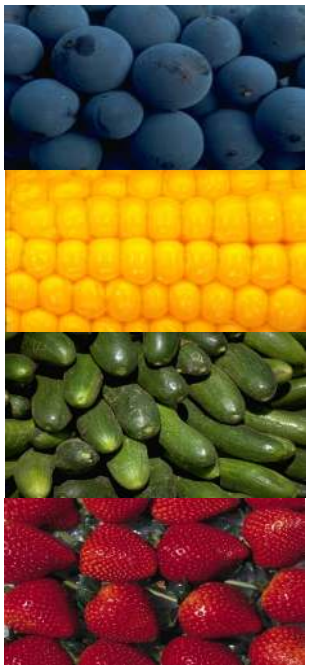
- Precise formulation specifications
  - No adjustments to ink on press
  - Inks must perform perfectly every time
  - Storage stability
- Inks are application specific
  - A particular printhead
  - A particular drive wave-form
  - Using specific drive electronics
- Physical property control
  - Particle size
  - Viscosity
  - Reliable jetting
  - Weathering

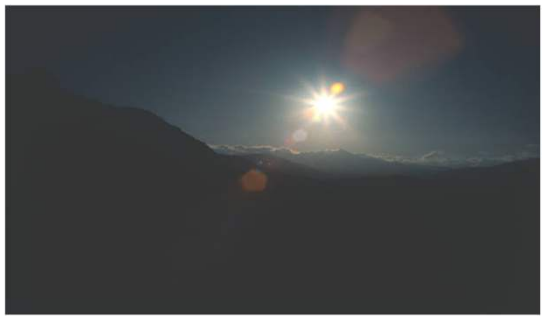
Printing Overview

	Gravure	Flexo	Lithography	Screen	Digital
Typical Print Speeds	**Up to 600 m/min**	**~ 450 m/min**	**600-700 (heatset) 15000-18000 iph (SF)**	**100 m/min (rotary)**	**30-100 m/min (state of art)**
Typical Ink Viscosities	**20-25 secs Zahn 2 0.05 – 0.2 Pa.s**	**20-25 secs Zahn 2 0.05 – 0.5 Pa.s**	**40-100 Pa.s**	**1 – 5 Pa.s (flatbed) Lower for rotary**	**6-15 mPa.s solvent/UV 2-5 mPa.s aqueous**
Typical Wet Film Thickness (µm)	**7 – 15**	**3 – 7**	**0.5 – 2**	**8 – 30**	**6 – 12 (multiple passes)**
Typical Particle Size	**< 8µm**	**< 4µm**	**< 4µm**	**-**	**Mean of 0.05 – 0.2µm Max. of 0.5 – 1.0µm**
Main Binders	**Nitrocellulose, Cellulose Acetate Proprionate, Polyvinyl butyral, Polyamide, Polyurethane, Polyvinyl,** Acrylics, Acrylated Oligomers	**Nitrocellulose, Cellulose Acetate Proprionate, Polyvinyl butyral, Polyamide, Polyurethane, polyvinyl,** Acrylics, Acrylated Oligomers	**Modified rosin esters (phenolic), Hydrocarbons, Drying oils (linseed oil, alkyds)** Acylated Oligomers	**Polyvinyls, Plastisol,** Acrylated Oligomers	**Polyvinyl, nitrocellulose,** Acrylated Oligomers
Main Solvents	**Alcohols (ethanol, n-propanol), Esters (ethyl acetate, n-propyl acetate), glycol retarders (ethoxy propanol),** Water **Ketones,** Acrylated Monomers	**Alcohols (ethanol, n-propanol), Esters (ethyl acetate, n-propyl acetate), glycol retarders (ethoxy propanol),** Water **Ketones,** Acrylated Monomers	**Petroleum distillates (heatset inks, 260-290°C), Mineral oils, Vegetable Oils (linsed, soya, rapeseed etc)** Acrylated Monomers	**Glycols,** Acrylated Monomers	**Water, Glycols, esters, ketones,** Acrylated Monomers

What is Color?

What is Color?





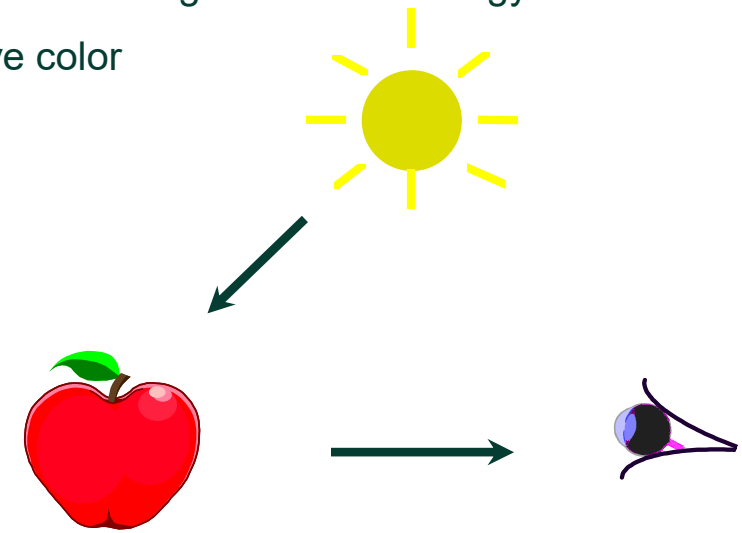
Color is the physiological perception of an object exposed to light

What does that mean?

No light —–> no color

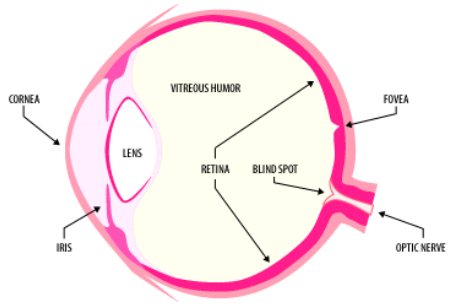
Three elements are necessary for perception of color:

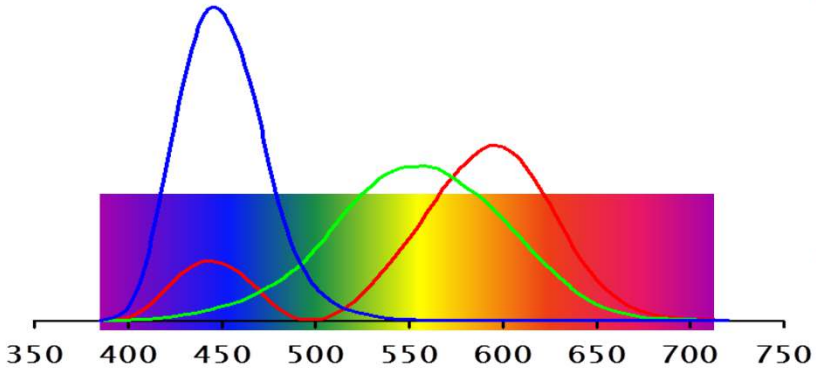
1. **Light:** emitting energy
2. **Object:** absorbs a part of energy and re-emitting the rest as energy
3. **Receptor:** vision allows us to perceive color



Perceiving Color – Color Vision

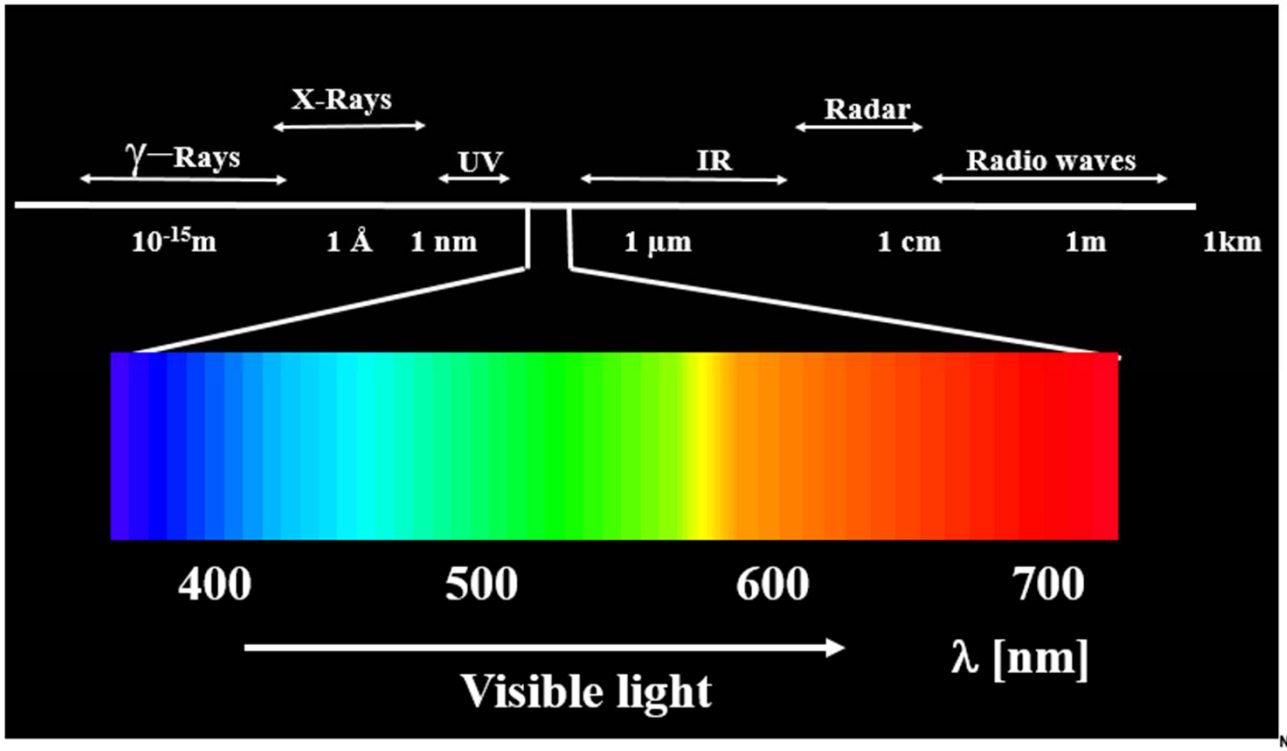
- Light enters the eye through the cornea, iris and lens and is imaged onto the retina.





- Light receptors, cones and rods, absorb some of the light and generate a signal that is interpreted by the brain.
- Cones are the receptors that are responsible for color.

Electromagnetic Spectrum



Describing Color

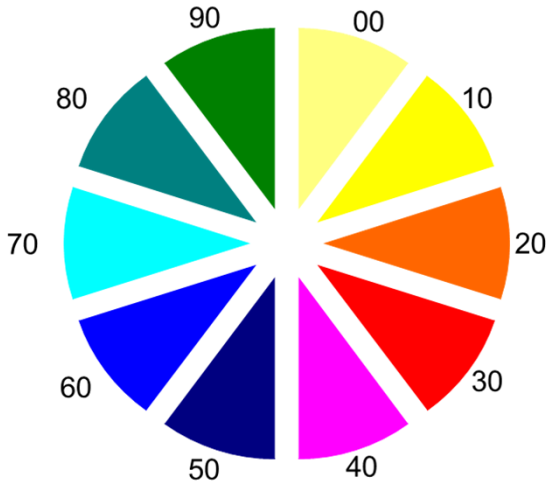
Lightness:

"Attribute by which a perceived color is judged to be equivalent to one of a series of grays ranging from black to white." (ASTM E 284)

Describing Color

Hue:

"Attribute of a visual perception according to which an area appears to be similar to one of the colors, red, yellow, green, and blue, or to a combination of adjacent pairs of these colors considered in a closed ring." (CIE 17.4)

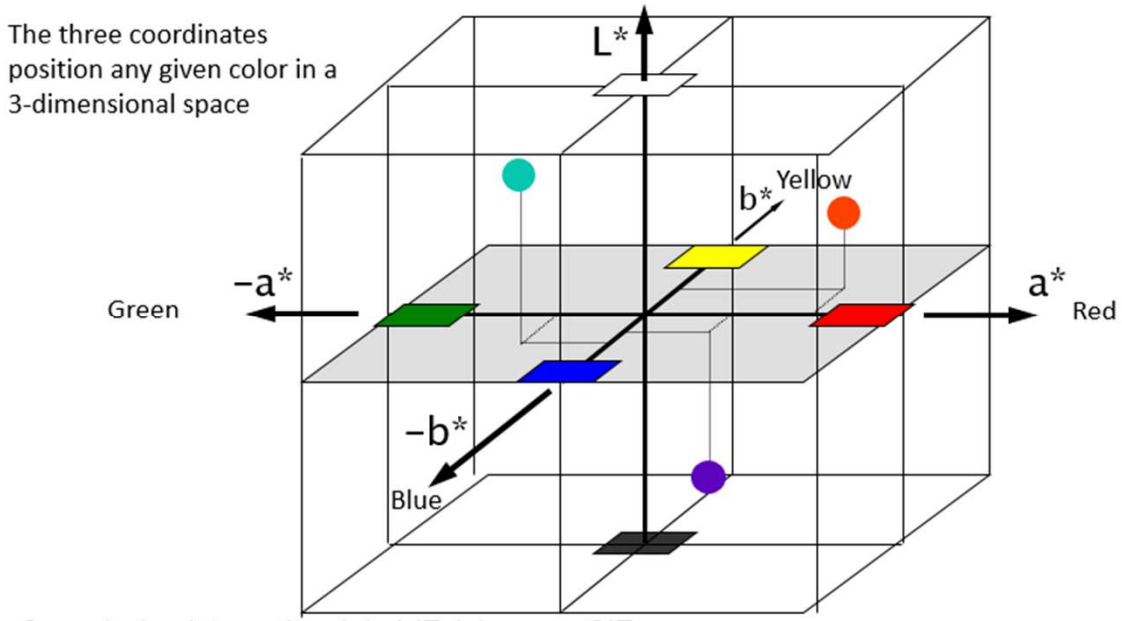


Describing Color

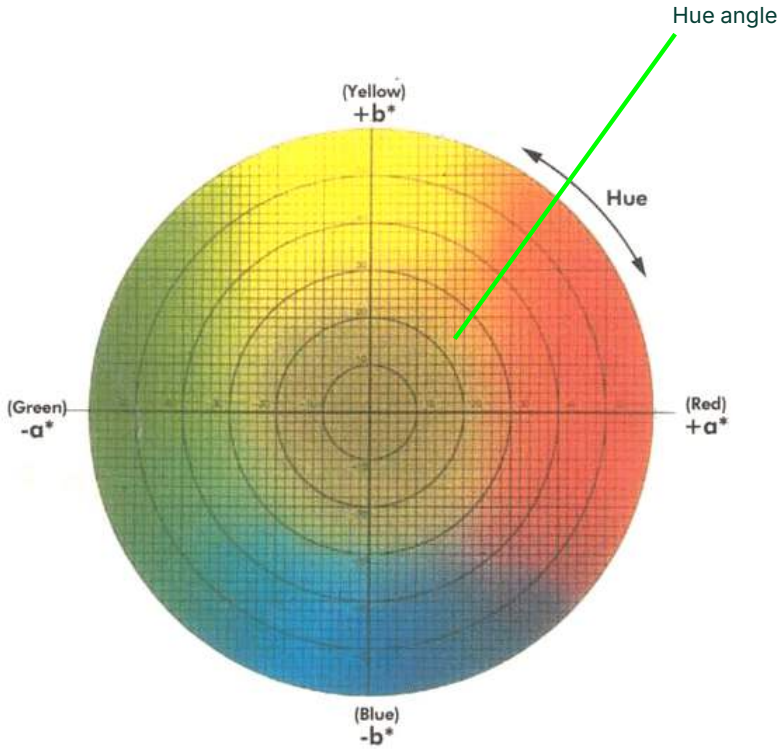
Chroma / Saturation:

"Attribute of color used to indicate the degree of departure of the color from a gray of the same lightness." (ASTM E 284)

(CIELAB) L*a*b* Color Space

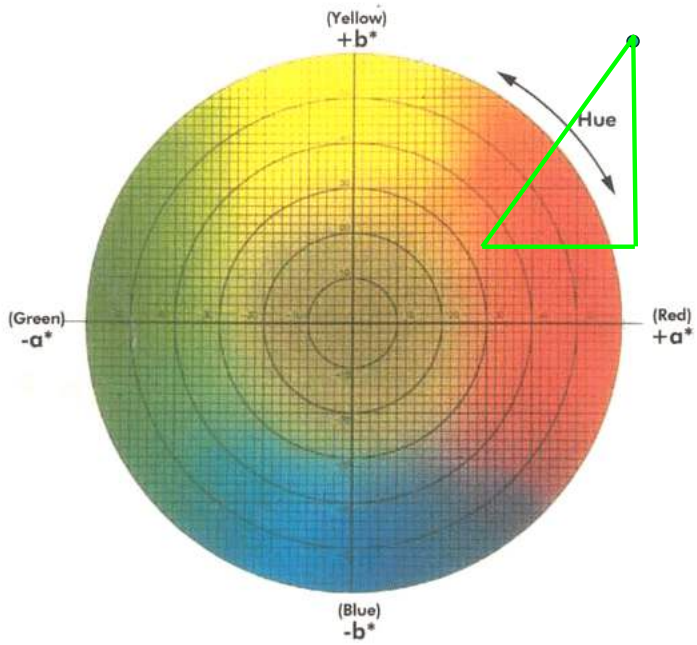


CIELAB Color Space



- Two additional coordinates, C* and h, are calculated from L*, a* and b*
- Hue, h, is a polar coordinate defining a color's position relative to the +a* axis (assigned 0°)
- Chroma, C*, represents a color's distance from the neutral center
- C* is the hypotenuse of the right triangle formed by a* and b*
- The hue angle can be determined through trigonometry

L*a*b* vs. L*C*h



- L*, a* & b* and L*, C* & h are simply two ways of describing the position of the same point
- L* = 61.15, a* = 30, b* = 40
- L* = 61.15, C* = 50, h = 53.13°

- Most of the US tends to prefer using the L*a*b* coordinates

Pigment Properties

As a powder:

Particle size
Specific surface
Oil Absorption
Density
Bulk density
Dry content
pH
Conductivity
Toxicity
Safety properties
Heat stability
Inherent Compatibility

In a medium:

Hue
Chroma
ΔE*
ΔH*
Color strength
Transparency
Hiding power
Flow properties
Dispersibility
Stability to flocculation
Heat stability
Fastness to overcoating
Weather resistance
Gloss

Opacity/Transparency

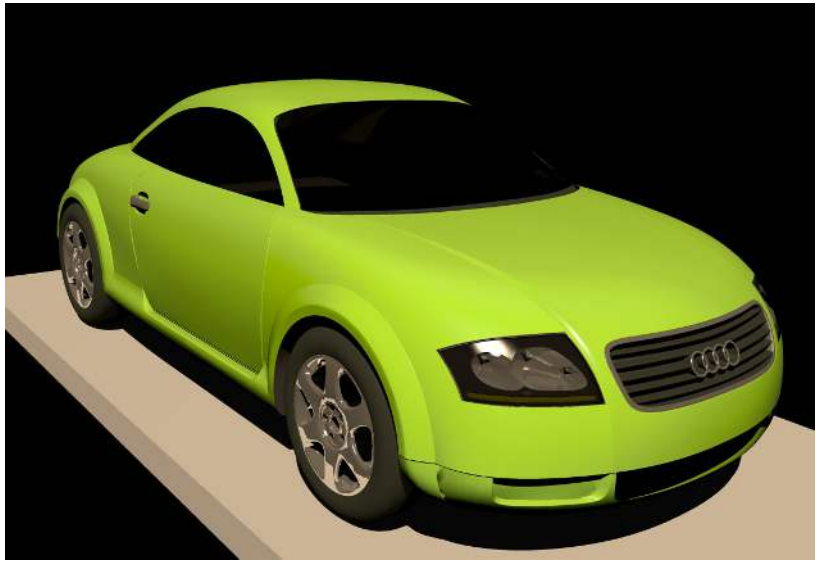
- Opacity and transparency are dependent on the ability of pigments to absorb and scatter light and therefore the light transmission through the ink
- Opaque pigments can be used in spot color
- Transparent pigments are used in process printing

What is Metamerism?

Metamerism on a Simulated Car

Metamerism is the phenomena in which two objects seem to have the same color under one light source, but different colors under another light source

Metamerism is caused by using different pigment chemistry or materials in the paint formulation



Illuminant F11 (TL84)

Illuminant D65

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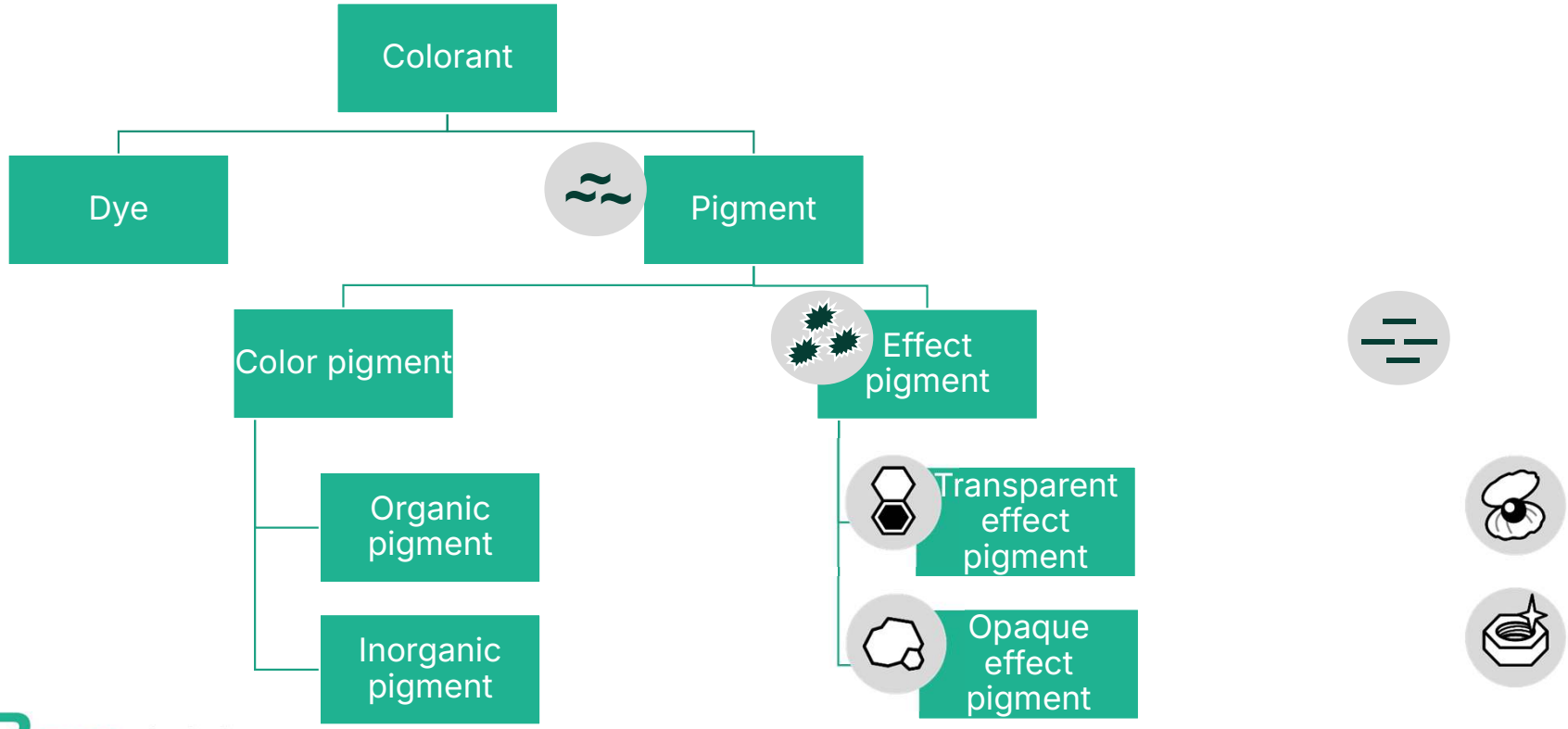
Colorants for Inks

Types of colorants



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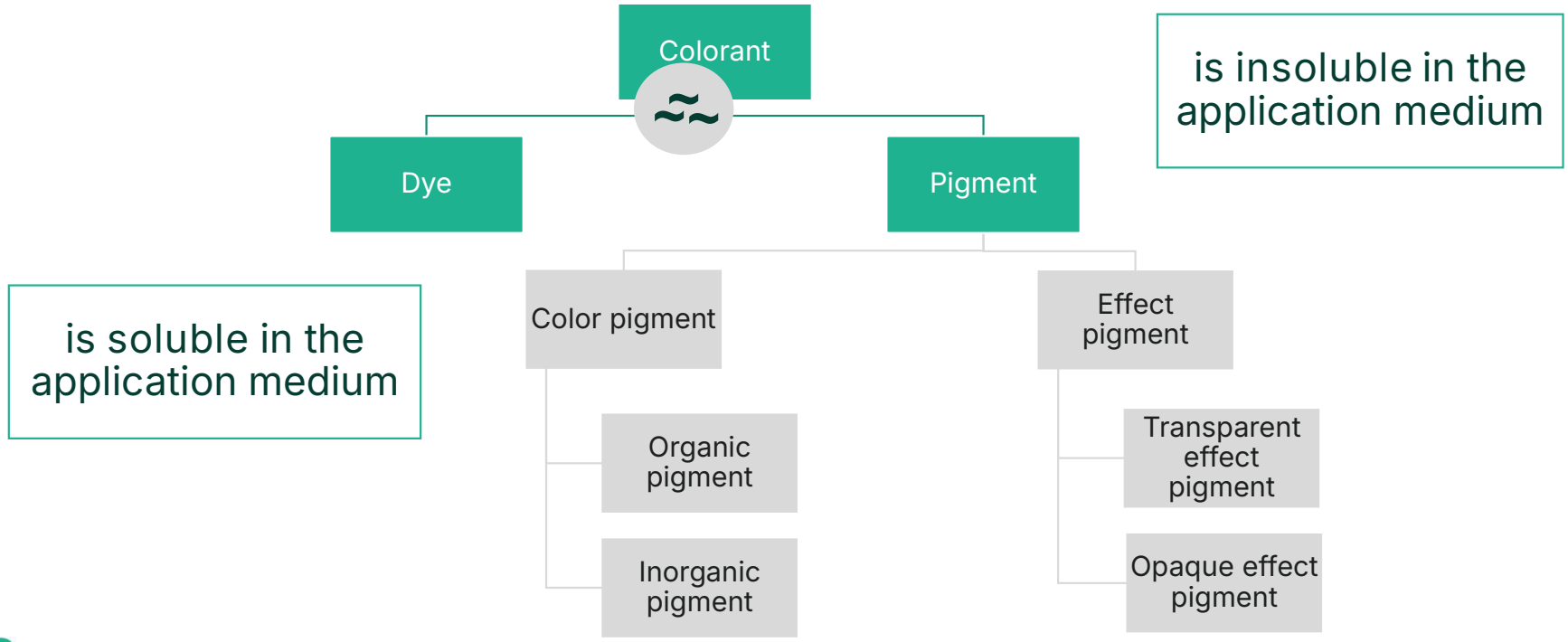
What is a dye?
What is a pigment?



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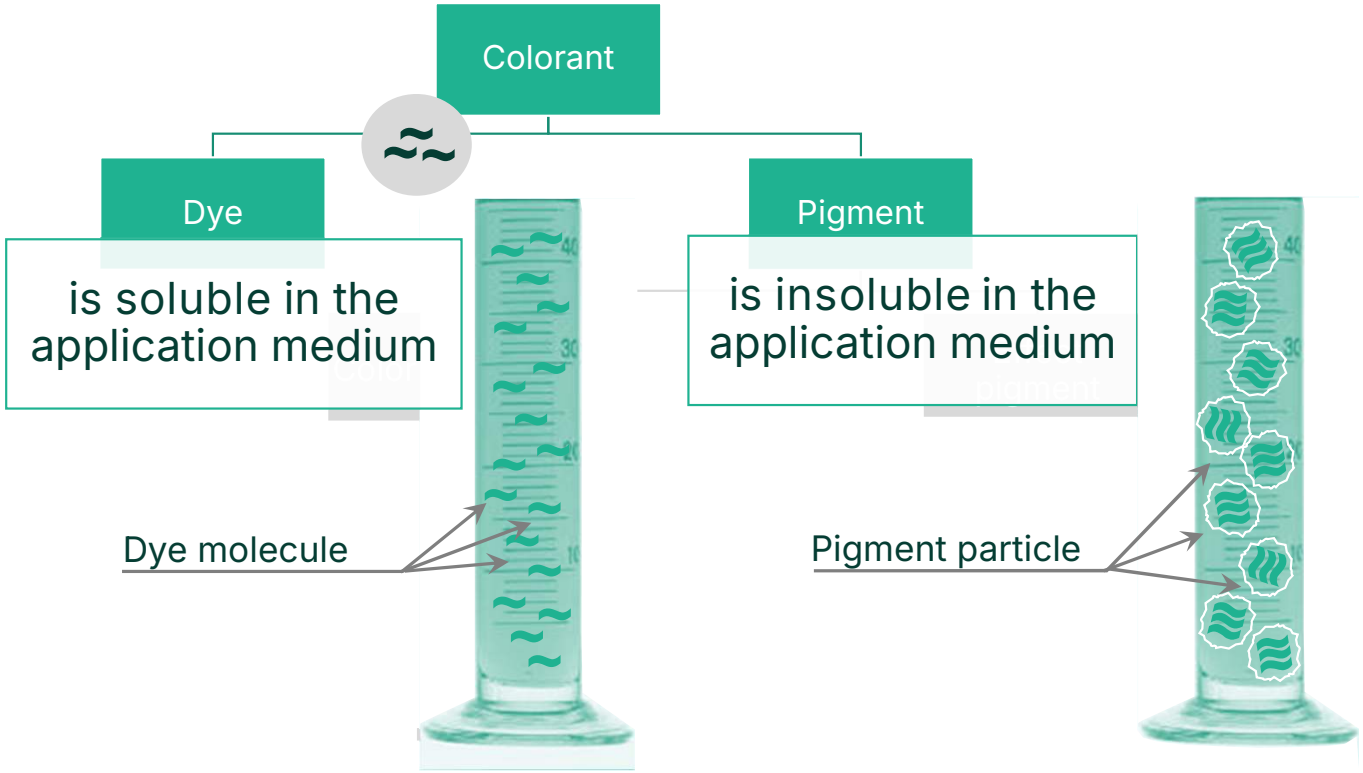
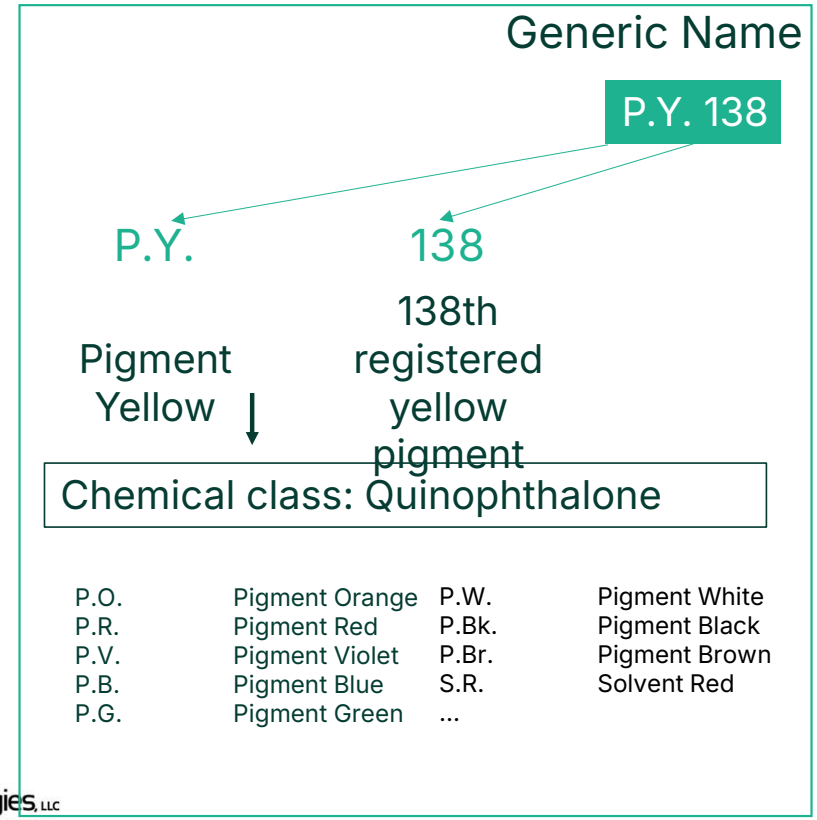


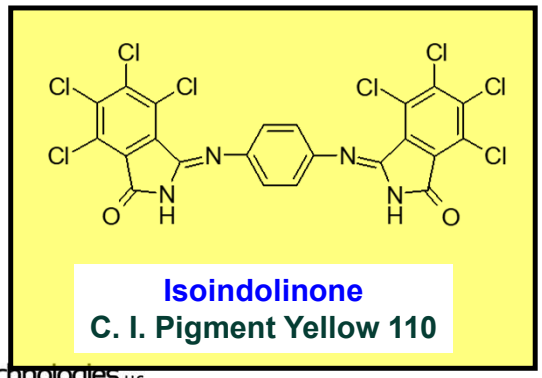
What is a dye?
What is a pigment?

What is Color Index?

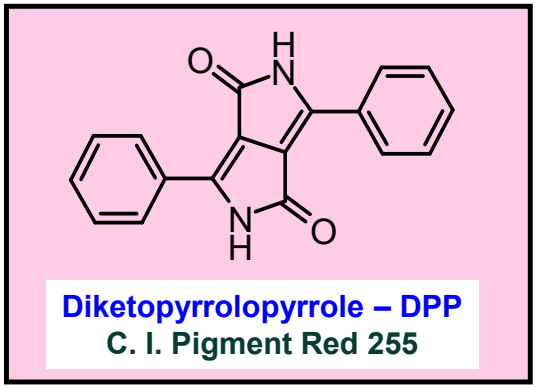


Color Index (CI)

- Indicates chemical constitution and color
- Chronological list at “Society of Dyes and Colorists“
- Enables communication about colorants without using brand names
- No information on particle size, crystal structure or surface treatment ...
- Products of the same color index may show different behavior in an application



Isoindolinone
C. I. Pigment Yellow 110



Diketopyrrolopyrrole – DPP
C. I. Pigment Red 255

C.I.Pigment Violet 19

Cinquasia® Red L 4100 HD

Cinquasia Violet L 5120

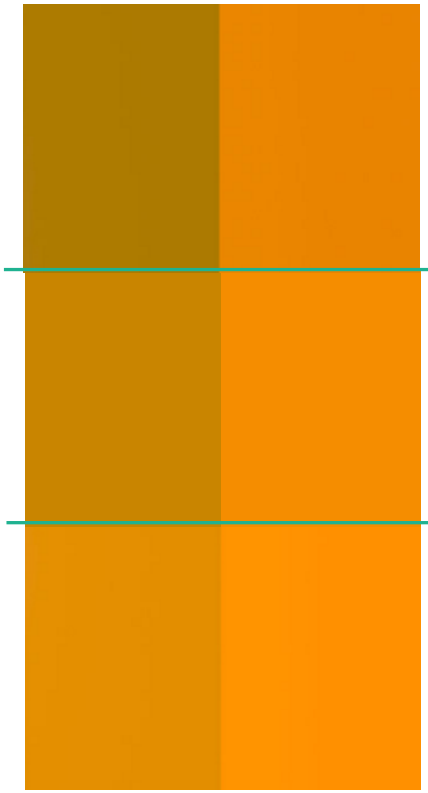
Mass Tone

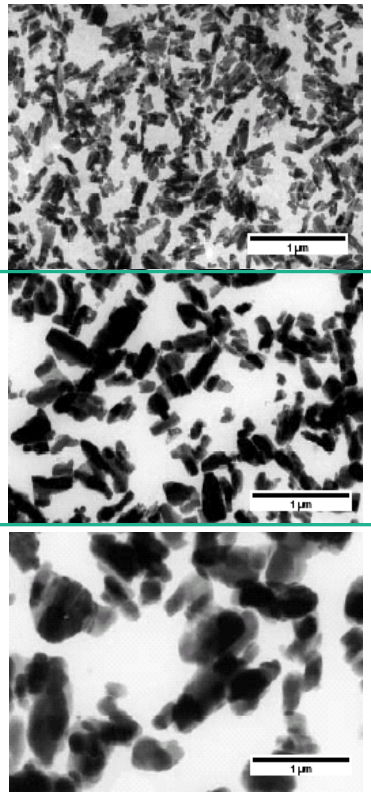
Same color index!!

Different appearance...

PY 139 Examples

Black & white substrate



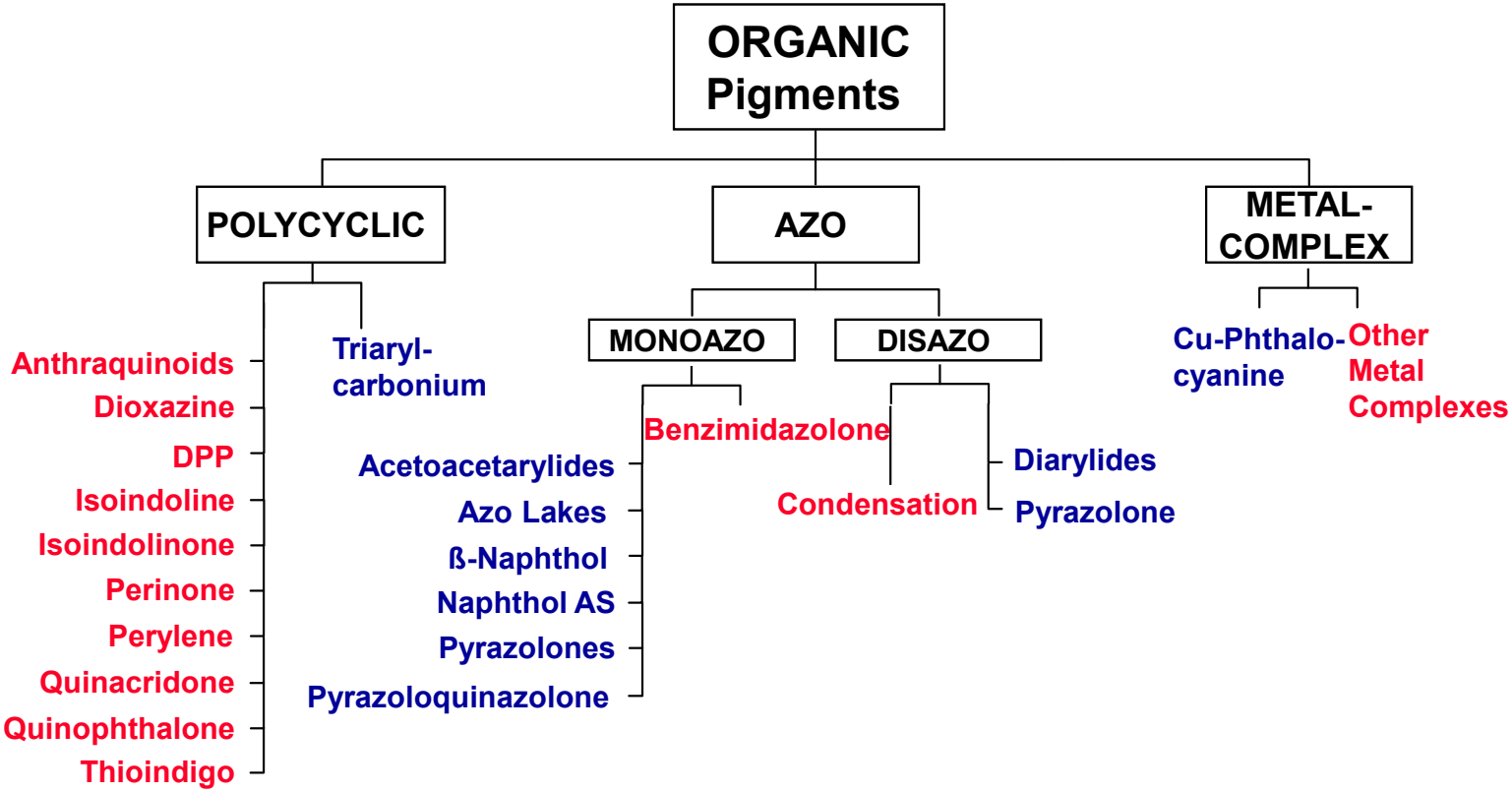


~130 nm

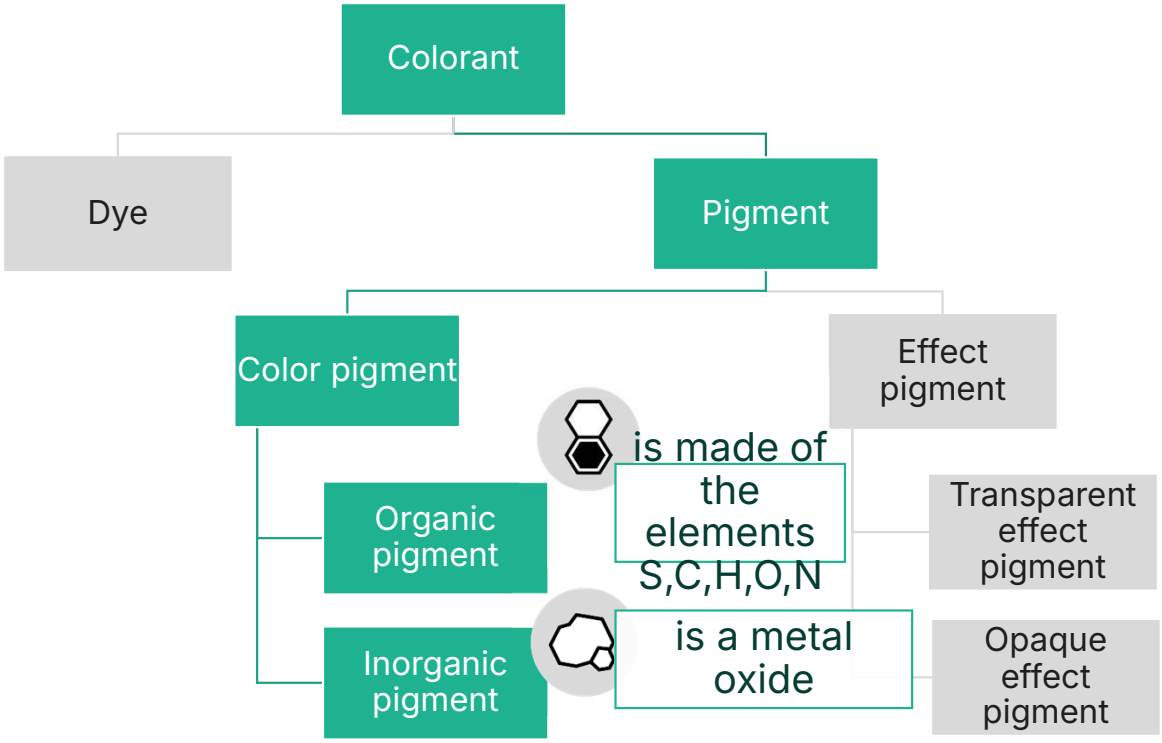
~200 nm

~300 nm

Organic Pigments

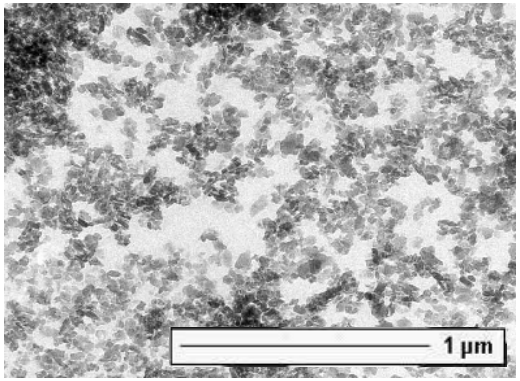


What is the difference between organic and inorganic pigments?

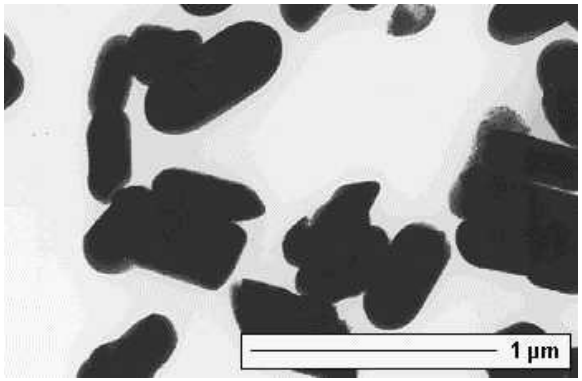


What do they look like under a microscope?

Organic pigment



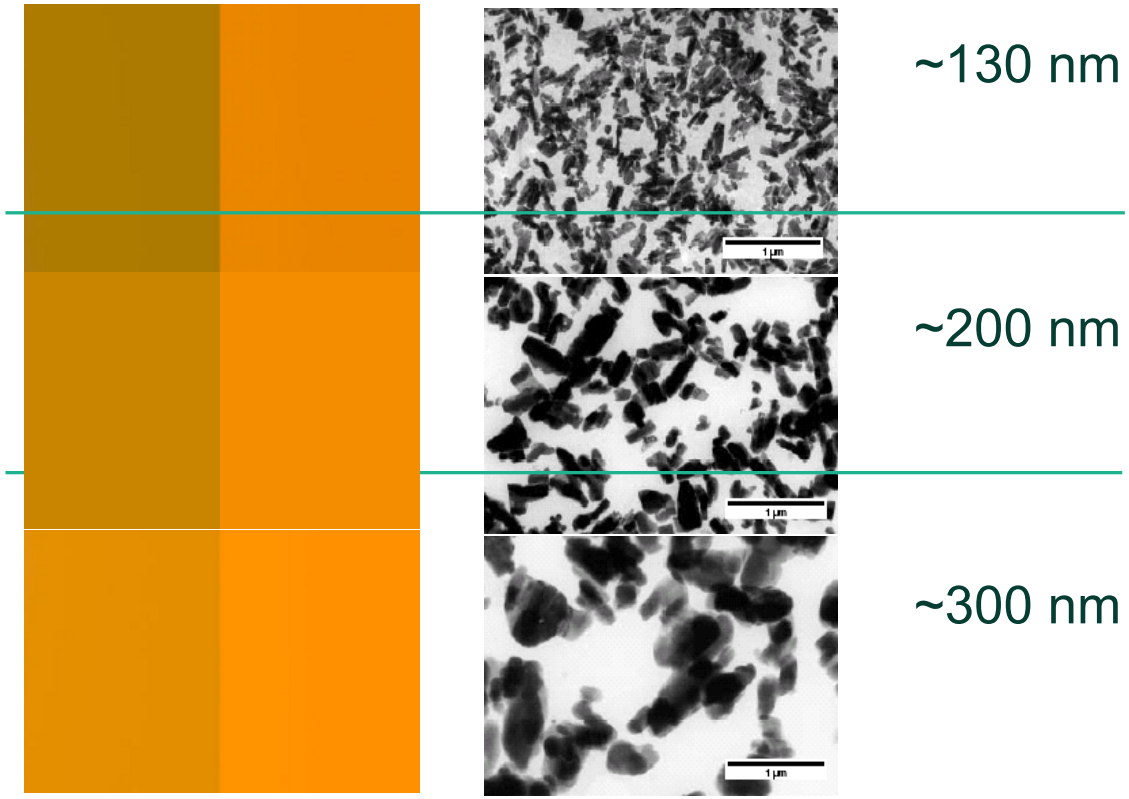
Inorganic pigment



Note: One human hair is about 100 microns in width or 100,000 nm!

Influence of particle size on transparency and opacity

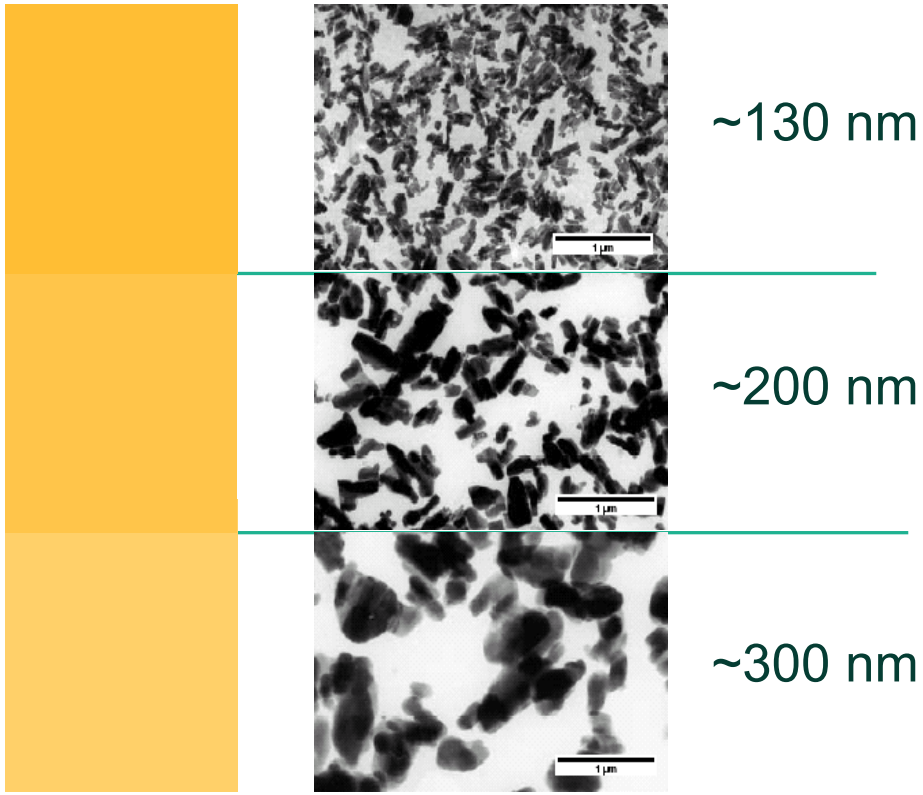
Black & white substrate



Influence of particle size on color strength

Color strength is a measure of the capability of a color pigment to have a coloring effect on other substances, e.g. white pastes.

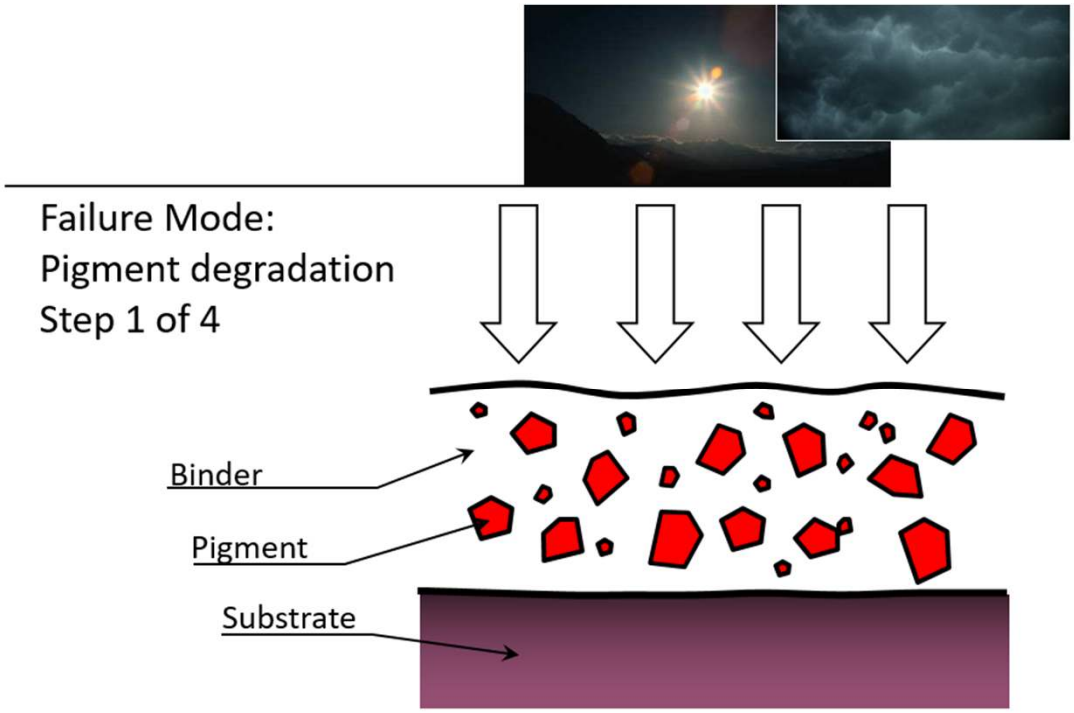
➔ The statement of color strength indicates the efficiency of a color pigment.



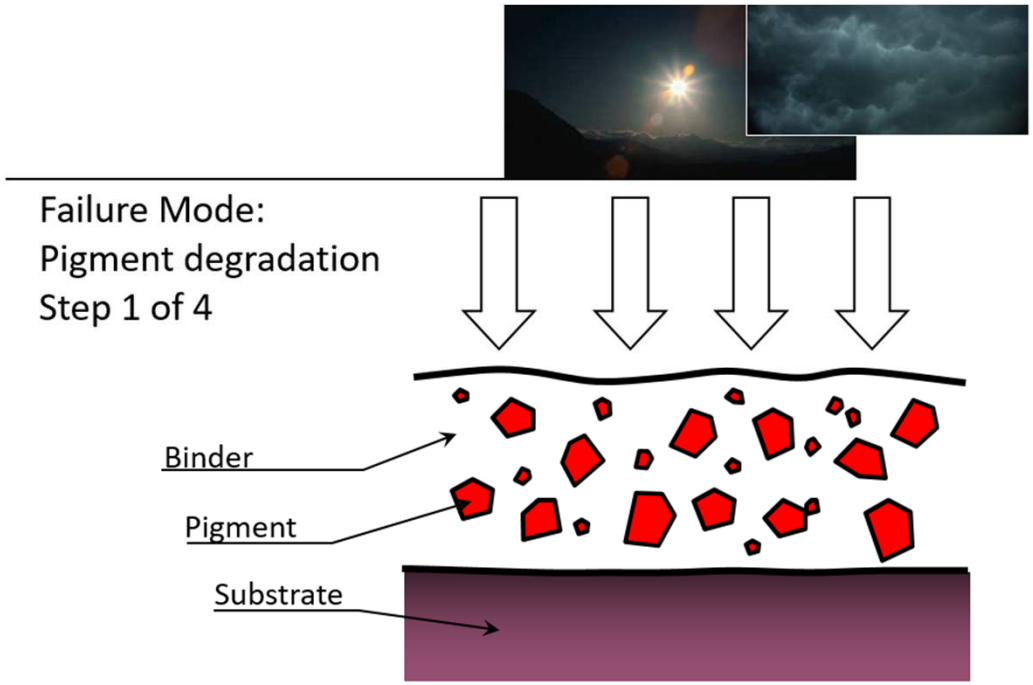
How do properties of organic and inorganic pigments relate to particle size?

Property	Organic	Inorganic
Particle size		
Transparency	☺	☹
Opacity	☹	☺
Color strength	☺	☹
Chroma	☺	☹

Fastness Properties



Fastness properties
e.g. weatherfastness



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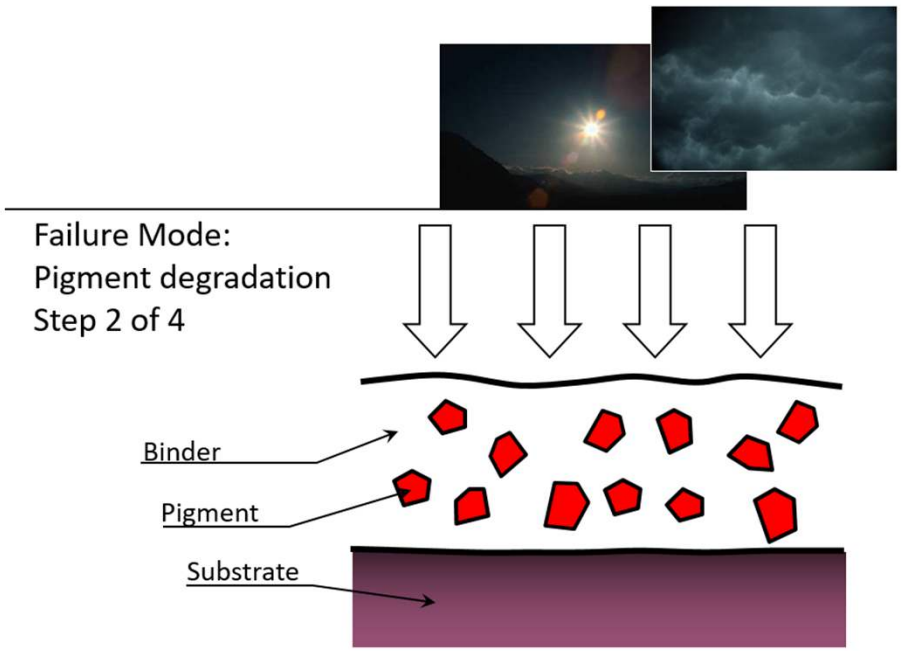

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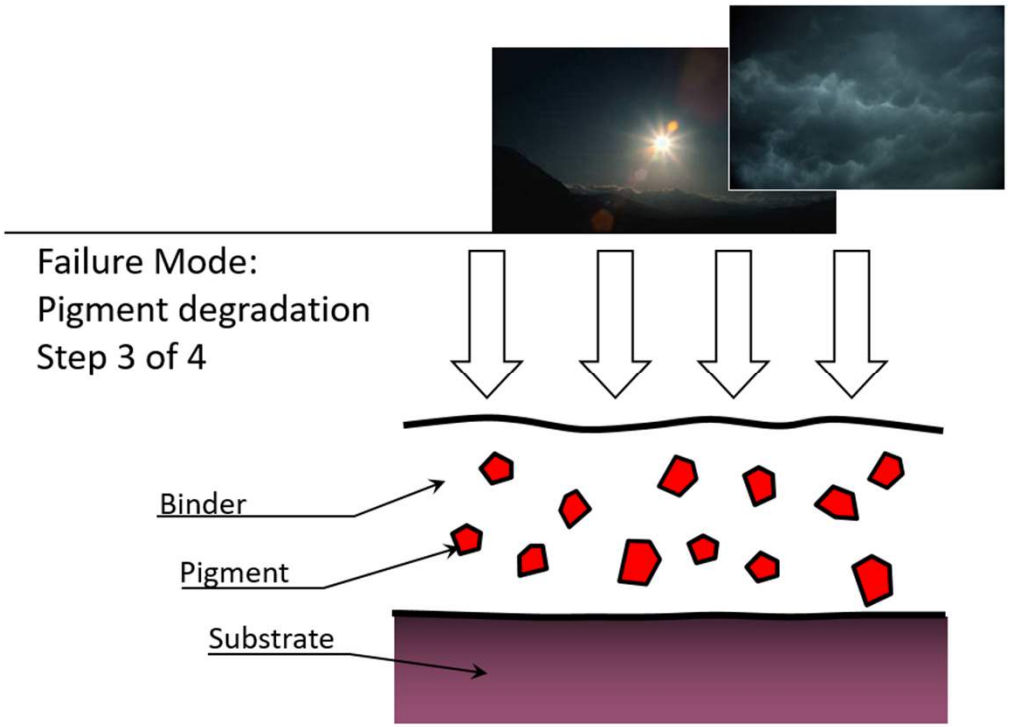

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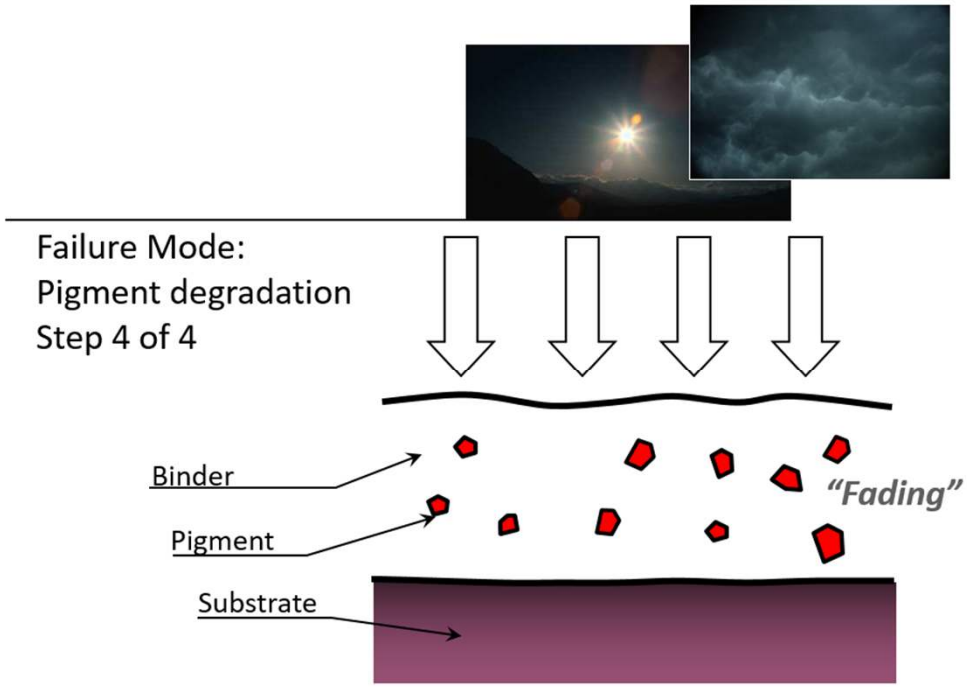


How do properties of organic and inorganic pigments relate to particle size?

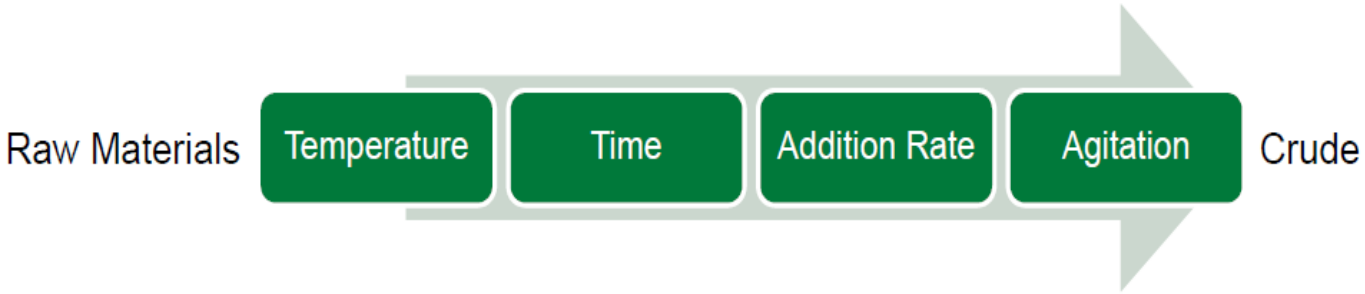
Property	Organic	Inorganic
Particle size		
Transparency	☺	☹
Opacity	☹	☺
Color strength	☺	☹
Chroma	☺	☹
Fastness properties	😐	☺

Pigments and Performance - Overview

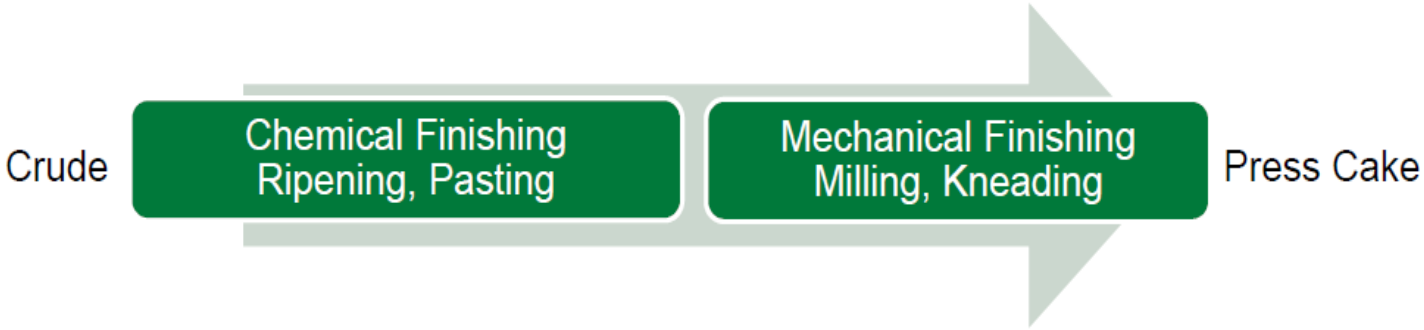
Pigment Properties	Inorganic	Organic Classical	Organic High Performance
Color, Purity	Often Dull	Usually Bright	+/- High
Opacity	High	+/- transparent	+/-transparent
Color Strength	Middle to Low	Normally High	Usually Bright
Lightfastness (Blue Wool Scale)	Good to High (7-8)	Low to Middle (<7)	Good to High (7-8)
Weather Resistance	Varies/Chemistry	Insufficient	Middle to High
Heat Resistance	> 500°C	150°C to220°C	200°C to 300°C
Solvent Fastness	High	Middle to Good	Good to High
Chemical Resistance	Varies/Chemistry	High except salts	High
Product cost	Low to Middle	Middle	High

Pigment Manufacture

Synthesis


Raw Materials
Temperature
Time
Addition Rate
Agitation
Crude

Chemical and Physical Conditioning



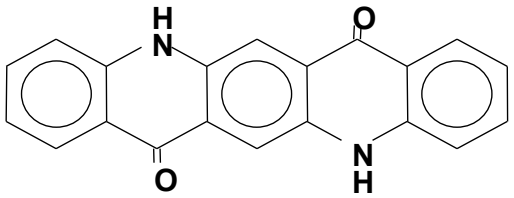
Finishing


Press Cake
Surface Treatment
Drying
Blending Packaging
Finished Product

Organic Pigments - Auxochromes

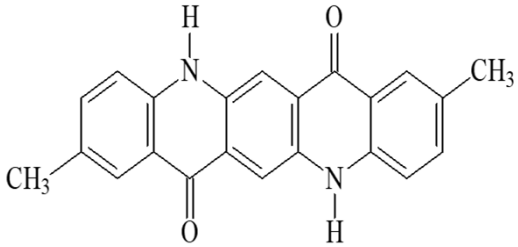
- Groups which enhance color are referred to as Auxochromes (auxo = increase)
- Substituting various groups for the hydrogen atoms on aromatic rings also contributes to the color of the pigment. These groups, such as –Cl, -CH3, -NO2, disturb the electronic structure of aromatic compounds; the distribution of absorbed wavelengths is shifted and a different color results.
- Groups include:
  - Amino
  - Alkylamino
  - Dialkylamino
  - Hydroxy
  - Methoxy

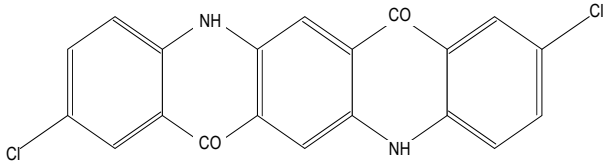
Organic Pigments: Auxochromes



Pigment Violet 19

Pigment Red 122





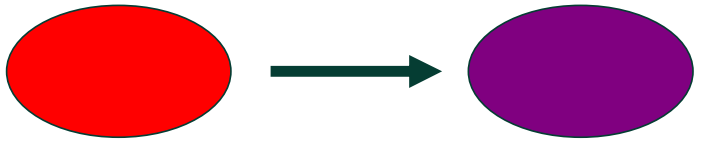
Pigment Red 202

Pigment Crystallography

Polymorphism

Arrangement of a molecule can be different in the crystal lattice. This leads to different pigments with different colour and performance :

Quinacridone (PV19)



β form – reddish violet γ form – bluish violet

Another example...

Cu-Phthalocyanine (PB15)

α form – reddish blue β form – bluish violet

PB15:1 stab., α reddish, offset

PB15:2 stab., α reddish, paints

PB15:3 β greenish, inks & plastics

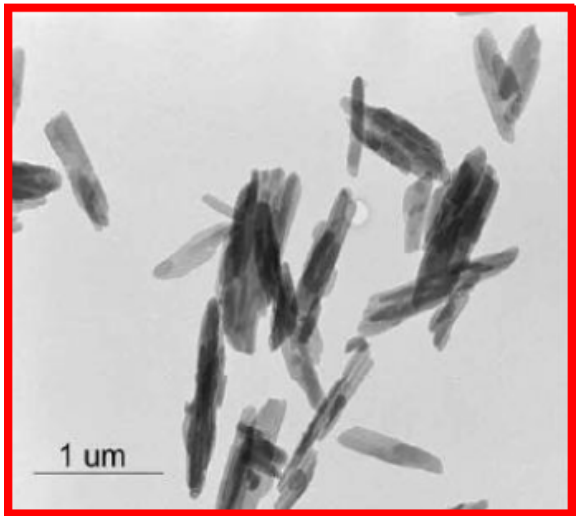
PB15:4 stab., β greenish, pack. inks & paints

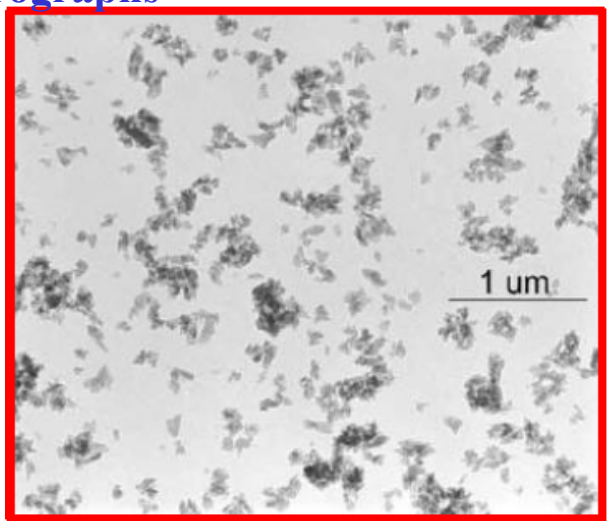
Pigment Crystallography

Particle Size

Crystal shape and size can be manipulated by both physical and chemical methods employed during the stages of manufacture and will play a key role in the end properties of the pigment.

Electron Micrographs

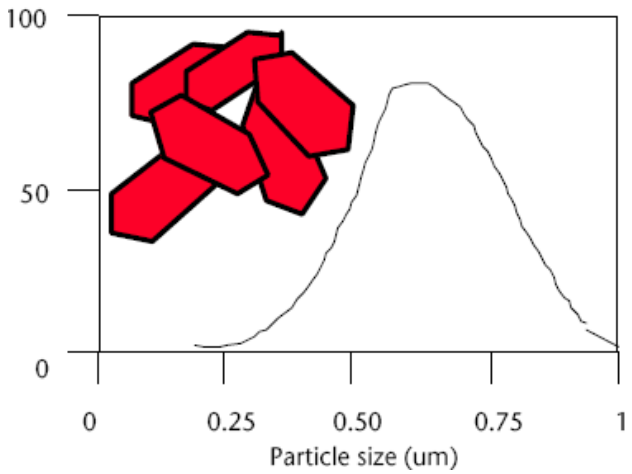


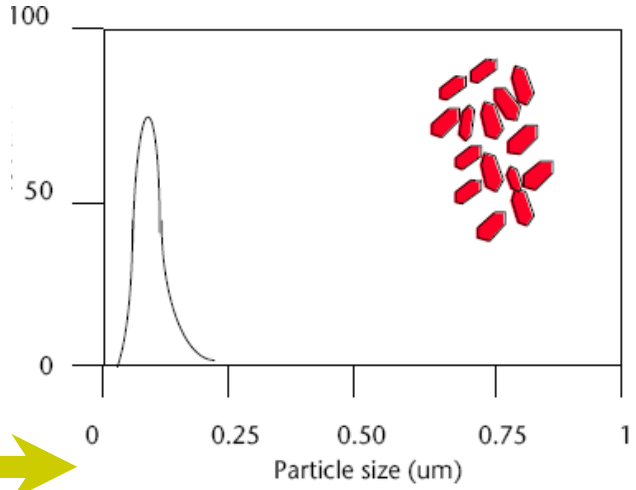


Products are the same color index!

Pigment Crystallography

Particle Size





Dispersibility

Opacity

Fastness

Color Strength

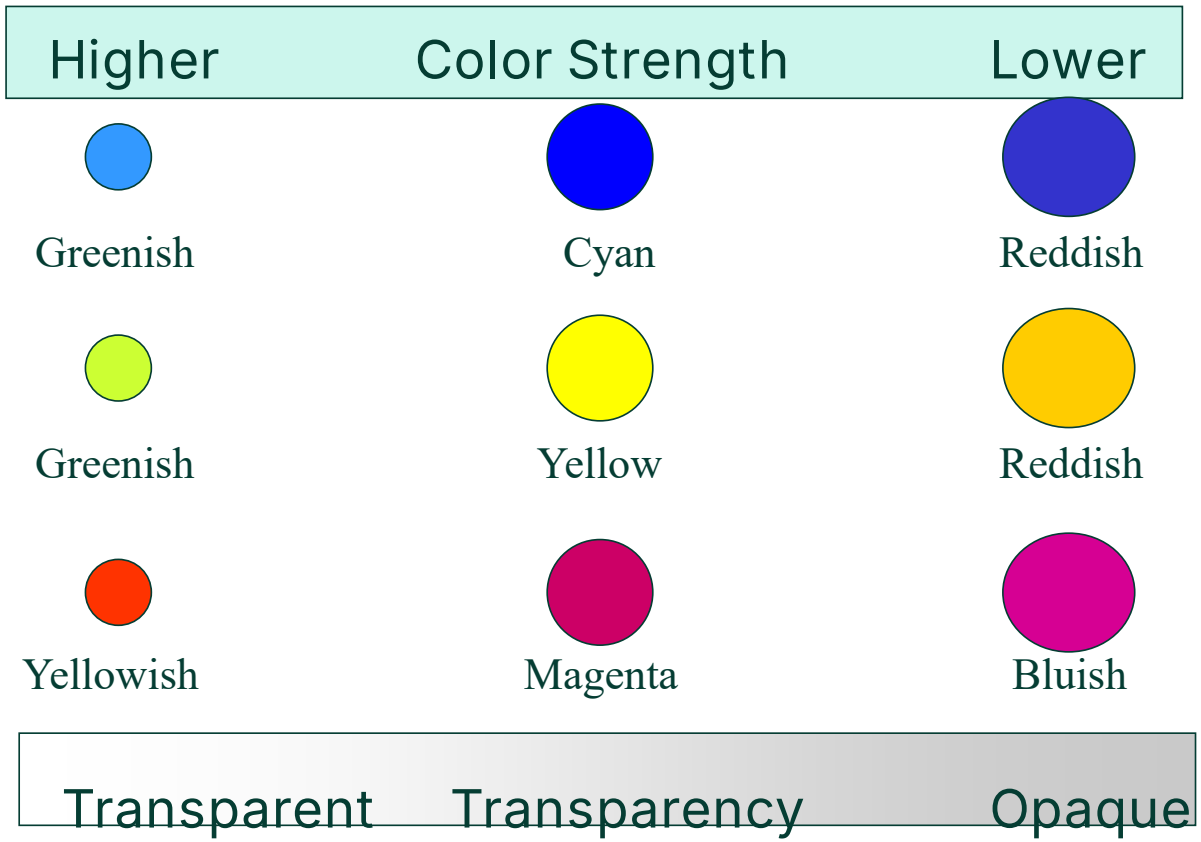
Gloss

Transparency

Ink Viscosity

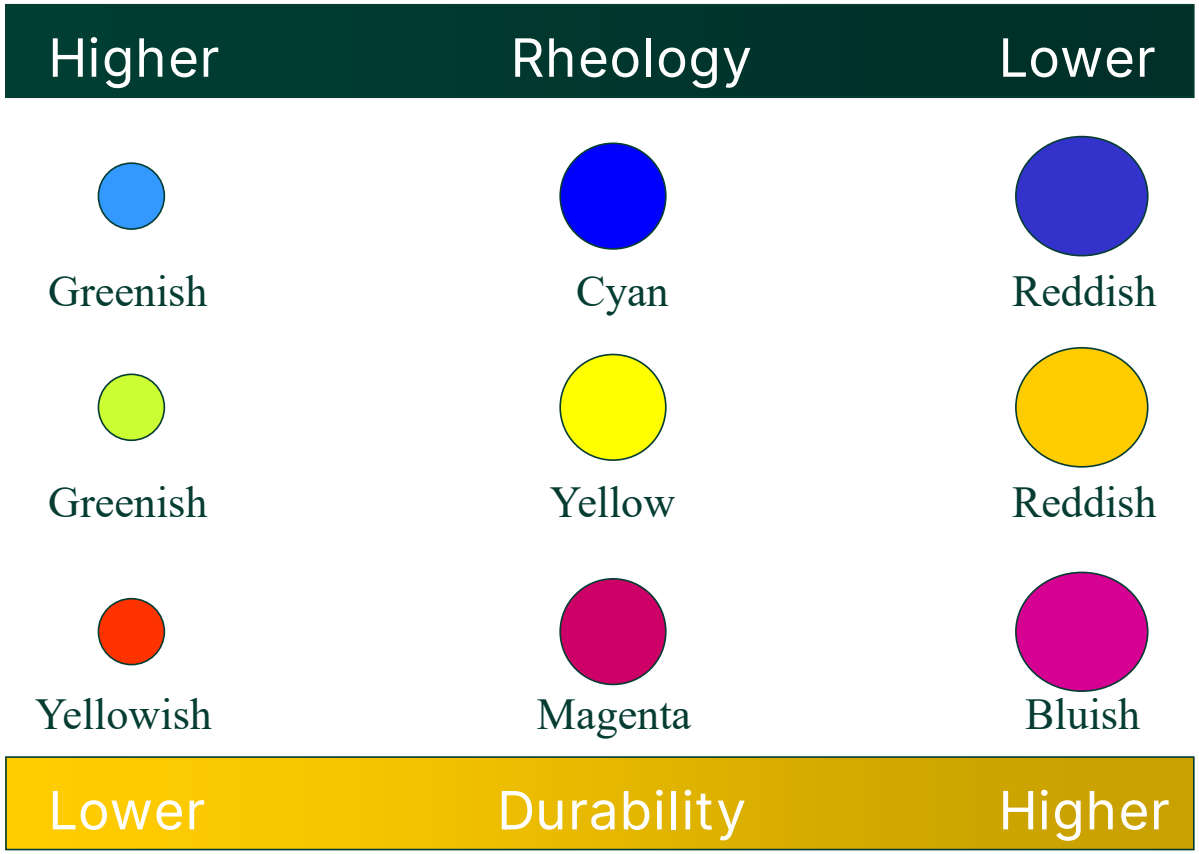
Pigment Crystallography

Particle Size and Coloristics



Pigment Crystallography

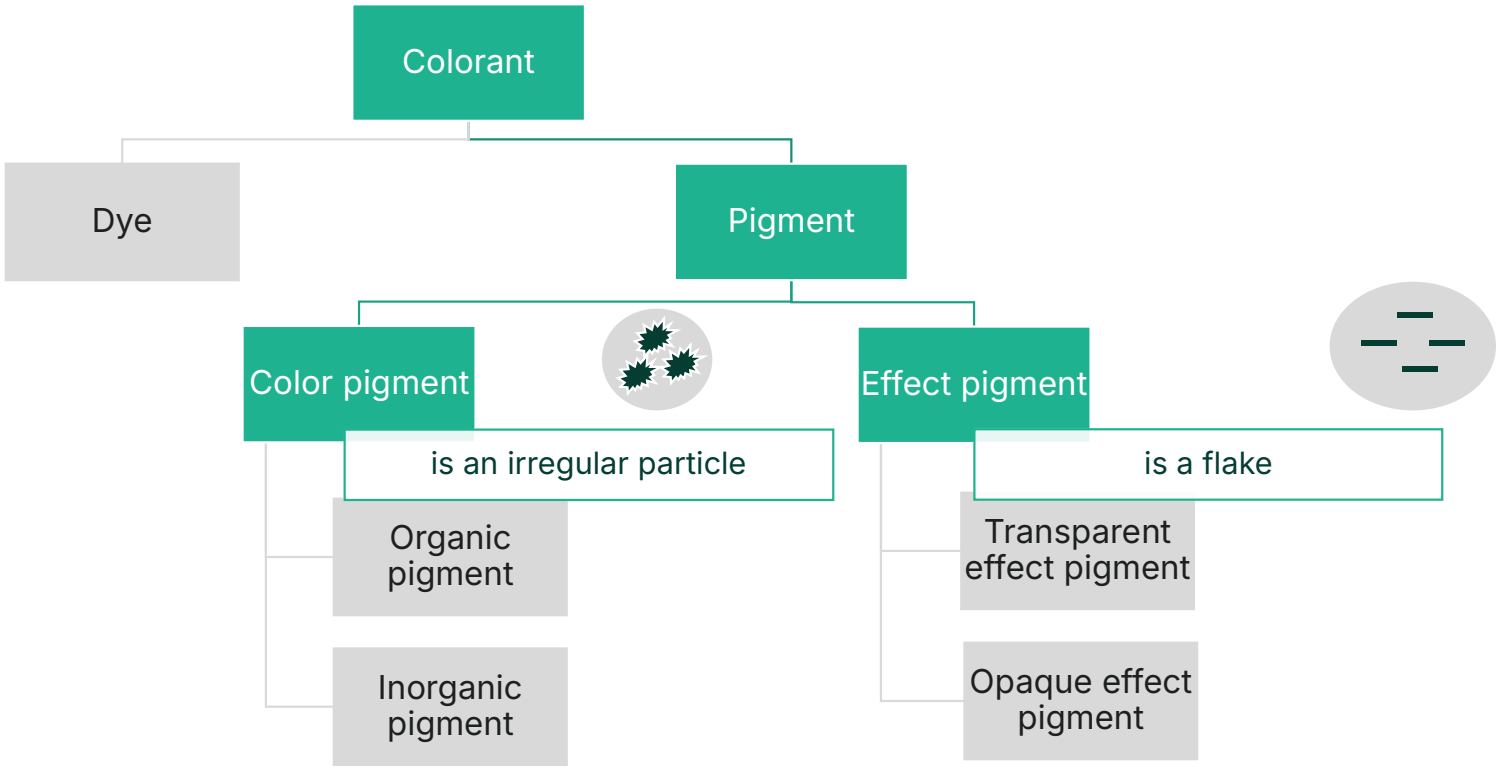
Particle Size and Physical Properties



Effect Pigments

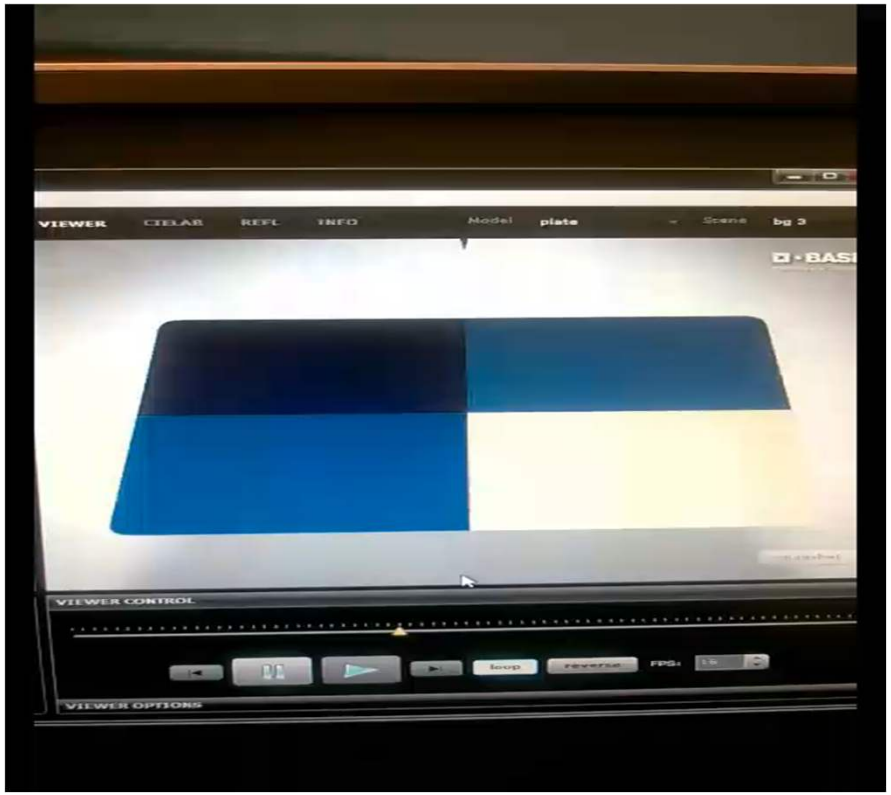
What is the difference between color and effect pigments?

What is the difference between color and effect pigments?



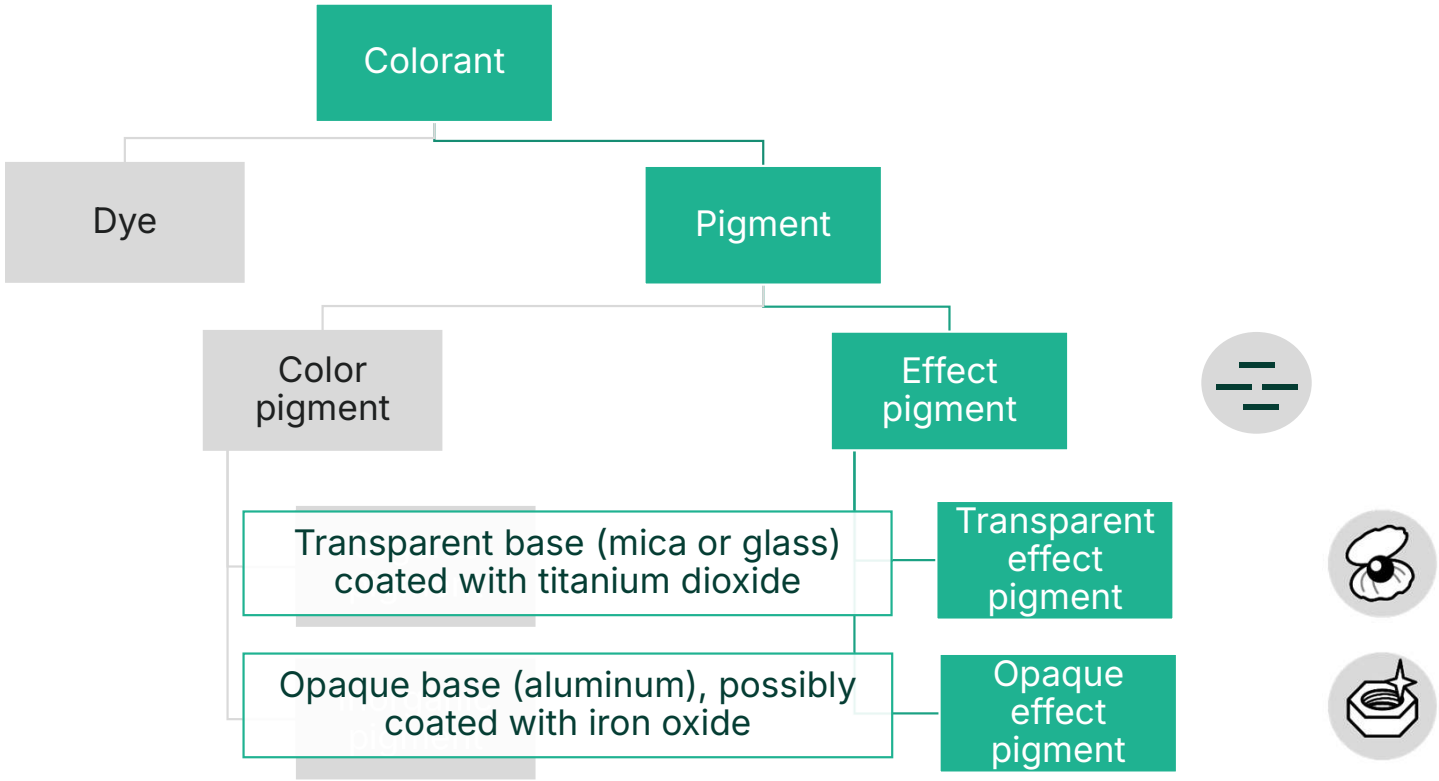
What is the difference between color and effect pigments?

Heliogen®
Blue L 7101 F
(PB 15:4)



Lumina®
Royal Ext.
Blue 6803H
(Coated
mica)

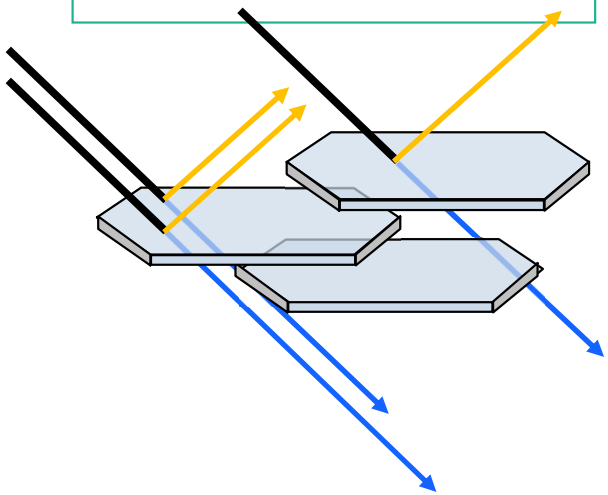
What is the structure of effect pigments?



How do effect pigments function?

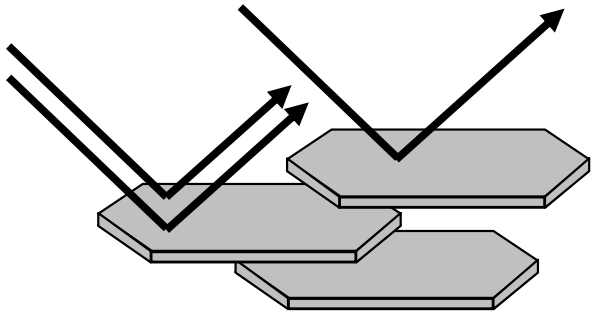
Transparent effect pigment

Reflection and transmission



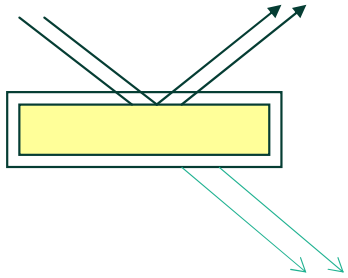
Opaque effect pigment

Reflection and possibly absorption

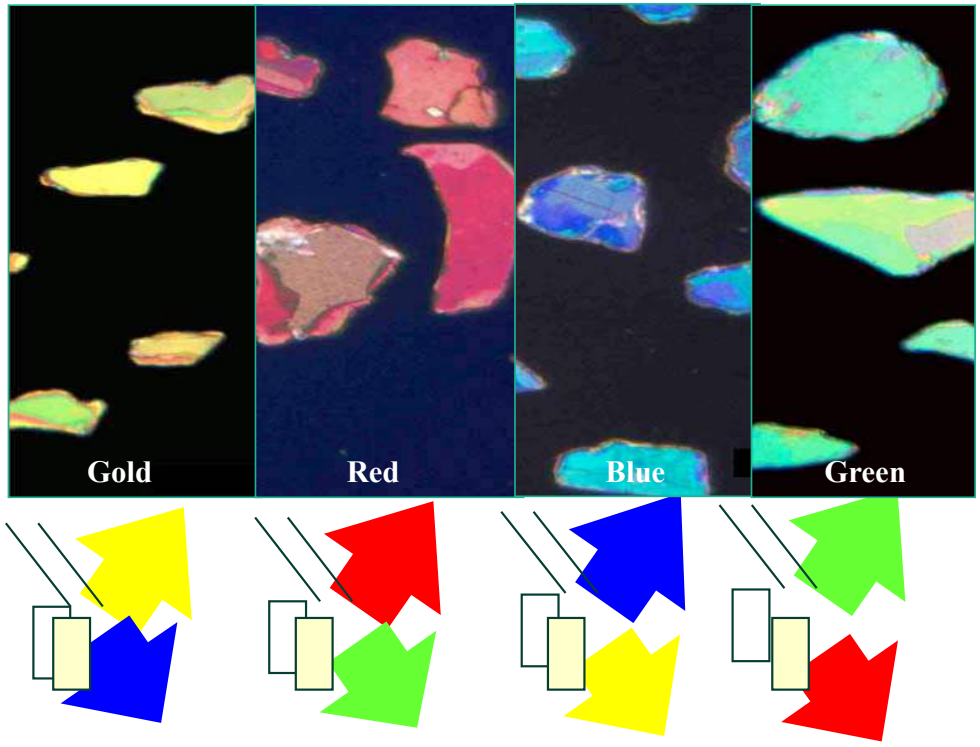


Transparent effect pigments e.g. based on mica

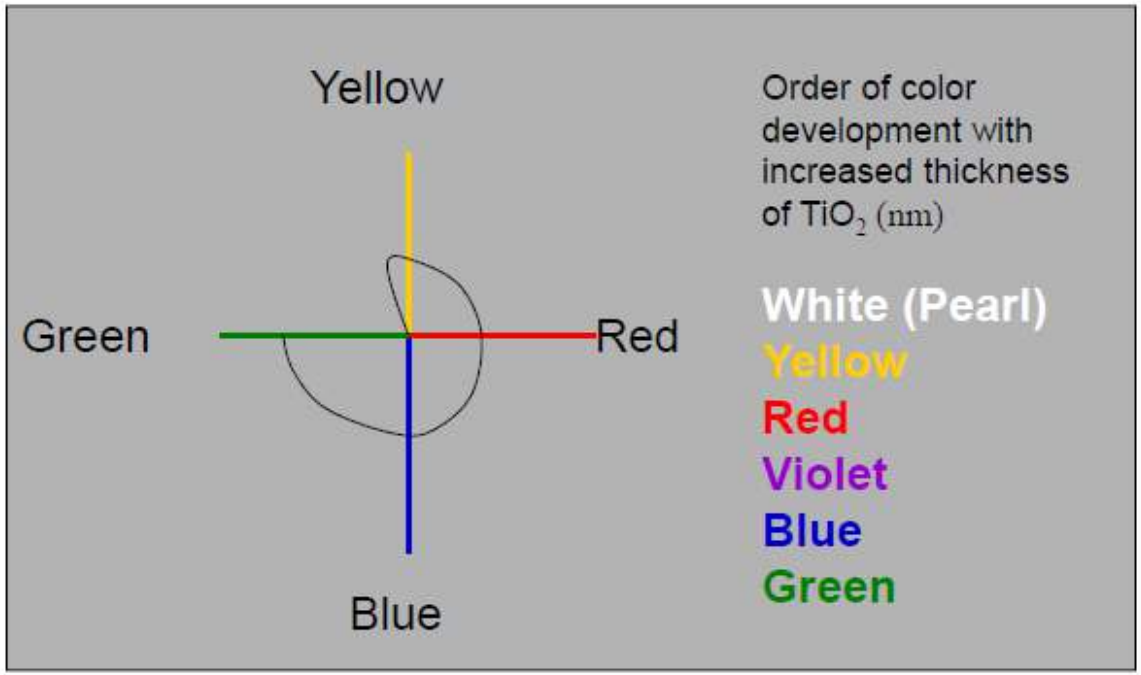
- Flake form after grinding
- Transparent, low refractive index
- Invisible in application medium
- Additional coating necessary
  - e.g. thin layer of TiO_2



Transparent effect pigments
Influence of coating thickness

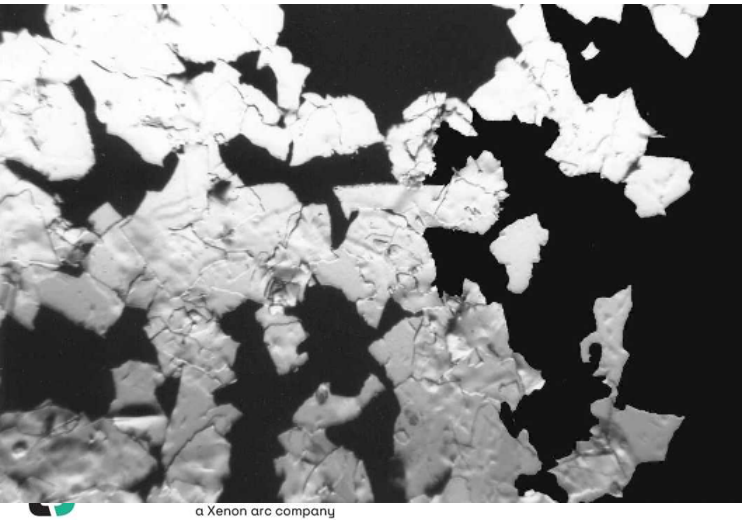


Thickness of layer determines the interference color



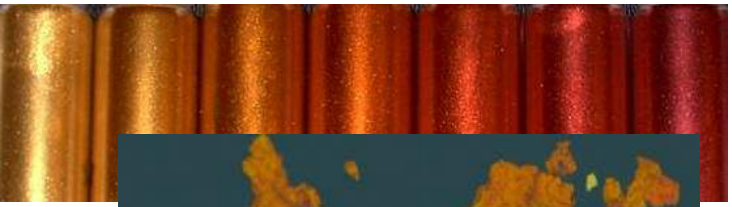
Opaque effect pigments – aluminum

- Vacuum-metallized or Pressure Vapor Deposition pigments
- Aluminum
- Mirror effects and “Liquid Metal”-effects



Opaque effect pigments – coated aluminum

- aluminum coated with iron oxide
- Cornflake-types = Standard
- Silverdollar-types = higher brilliance because of smoother surface



Effect Pigment Key Points

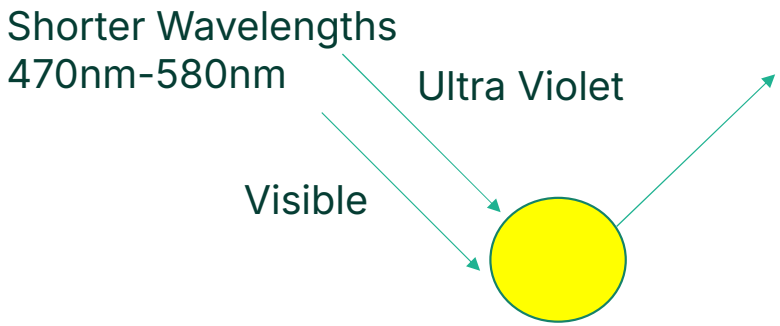
- Stir in only!
  - High shear mixing with media or 3 roll mills will destroy the effect!
  - Generally “large” particle size (relative to standard inks)

Fluorescent Pigments

Daylight Fluorescent-Defined

- Light of short wavelengths, either ultraviolet or visible, is absorbed and re-radiated at longer wavelengths; the re-emission occurs within the visible region of the spectrum and consequently is manifested as color
- Typically >100% reflectance
- Peak excitation 470nm-580nm
- Peak emission 520nm-610nm

Visual Model



Re-emission in visible region; greater than 100% Reflectance (520nm-610nm). This is why they appear “brighter” or fluorescent

Fluorescent Pigment Technology-Chemistry

- Polymer
  - Melamine-Formaldehyde-Sulfonamide (MFS)
  - Benzoguanamine-Formaldehyde
  - Polyester
  - Polyamide
  - Acrylic
- Fluorescent Dyes

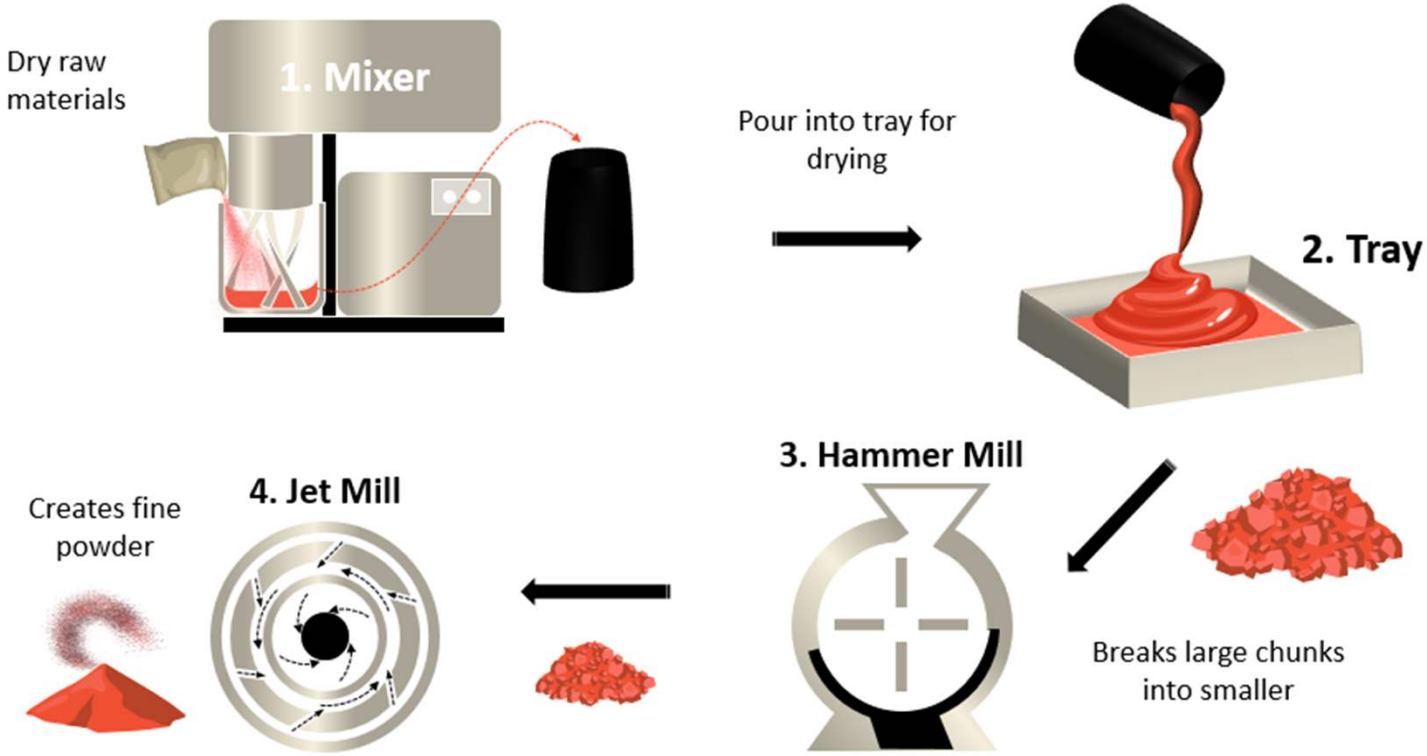
Fluorescent Pigment Manufacturing Technology

- Bulk Polycondensation
- Suspension Polymerization
- Emulsion Polymerization
- Coloration Occurs During Polymerization
- Not After Polymer is Formed

Fluorescent Pigment Manufacturing Technology

- Bulk Polycondensation
  - Add Raw Materials To Vessel
  - Mix and Heat
  - Molecular Weight & Viscosity Build
  - Pour Out Of Vessel and Let Solidify
  - Optional Post Curing
  - Mill Into Fractured Particle
  - Typical Softening Point 80-120 deg C

Production


Dry raw materials
1. Mixer
Pour into tray for drying
2. Tray
3. Hammer Mill
Breaks large chunks into smaller
4. Jet Mill
Creates fine powder

Fluorescent Pigment Manufacturing Technology

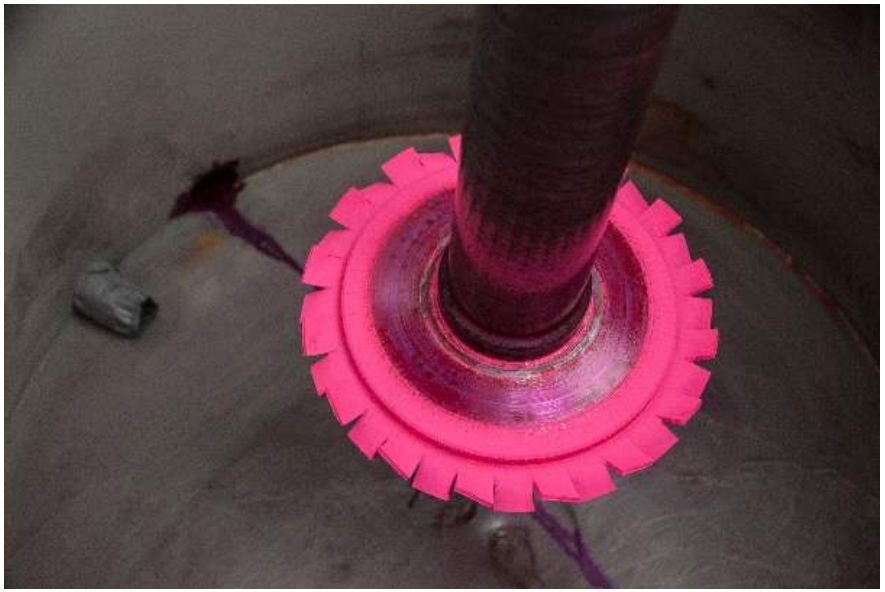
- Suspension Polymerization
  - Start With Non-Reactive Liquid
  - Add Raw Materials, Mix and Heat
  - Molecular Weight Builds, Viscosity Doesn’t
  - Filter and Dry
  - Spherical Particles
  - Completely Crosslinked, Most Inert
  - Decomposition Point 290 deg C

Fluorescent Pigment Manufacturing Technology

- Emulsion Polymerization
  - Start With Non-Reactive Liquid
  - Add Raw Materials
  - Free Radical Catalysis, Exothermic
  - Molecular Weight Builds, Viscosity Does Not
  - Spherical Particles, Typically Submicron
  - Liquid Gets Used As Is

Fluorescent Pigments-Product Types

- Bulk Polycondensation
  - MFS
  - Polyester
  - Polyamide
- Suspension Polymerization
  - Benzoguanamine
- Emulsion Polymerization
  - Acrylic



Fluorescent Pigments-Product Types

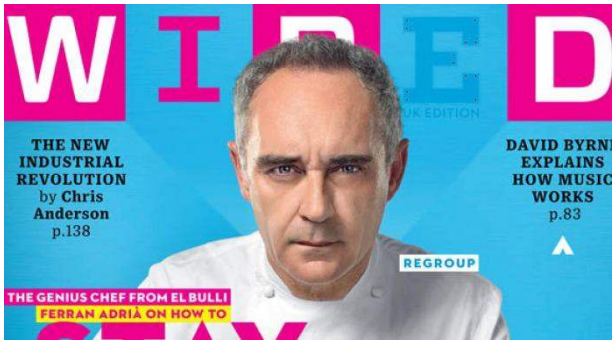
- Results in Over Twelve Different Lines
  - Dry Pigments
    - Water, Solvent, Plastics Melt-In, Non-Migrating
  - Soluble Toners
    - Soluble in Either Water or Solvent Systems
  - Water-Based Dispersions
  - Ink Bases for Conventional or UV Offset
  - Liquid Vinyl Colorants

Fluorescent Pigments-Applications

- Paints
- Powder Coatings
- Inks
- Plastics
- Textiles
- Other

Fluorescent Pigments For Inks

- Lithographic Inks
  - Conventional and UV
- Flexo Inks
  - Water, Solvent and UV
- Gravure Inks
  - Water, Solvent
- Digital Inks
  - Solvent



Fluorescent Pigments: Many Chemistries + Applications

- Broad Range of Chemistries/Technologies
- Many Applications
- It Is Important To Select The Right Product For The Application
- One Size Does Not Fit All
- Stir-in only!

How are colorants used in inks?

How do you make sure the pigment sticks to the substrate?

Pigment

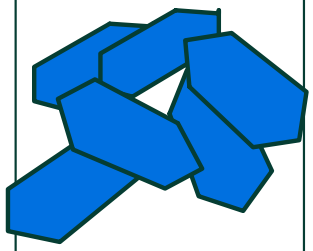
Dispersing agent,
Resin, Additive,...

Dispersion process,
e.g. dissolver

Pigment paste,
Coating / Ink

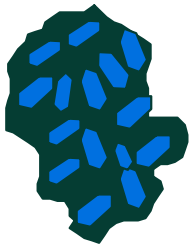
Product Forms

Pigment



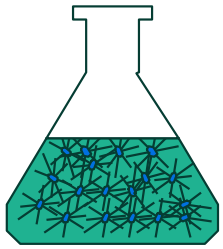
Insoluble Particles
Fine Powder
Coarse Powder-SG
Granules
Presscake

Pigment Preparations



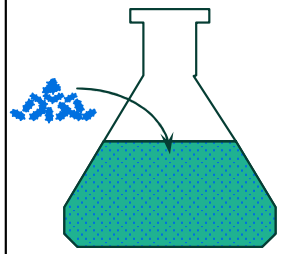
Insoluble Particles,
Soluble Binder

Liquid Dispersions



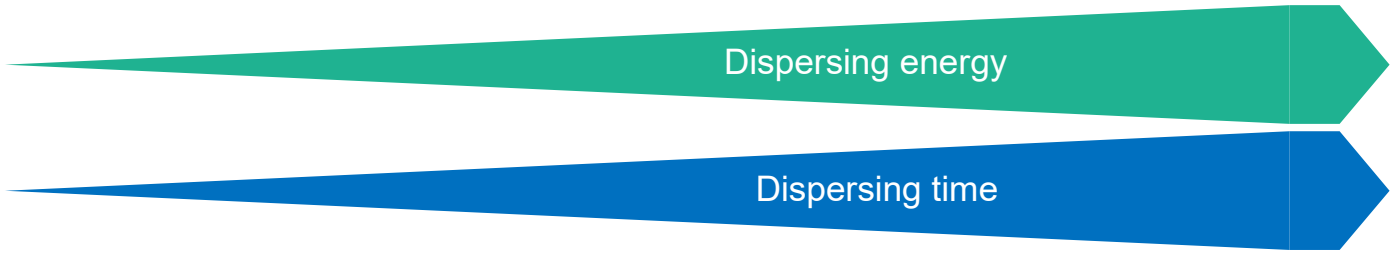
Insoluble Particles,
Dispersion Agent
(Soluble Binder)
Stable Dispersion
Includes flushes

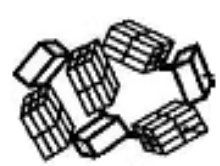
Dyes



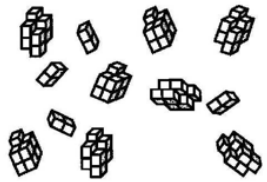
Soluble Particles
Molecular
Distribution

Dispersion process



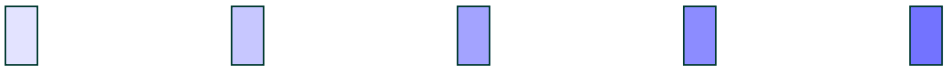


Agglomerates

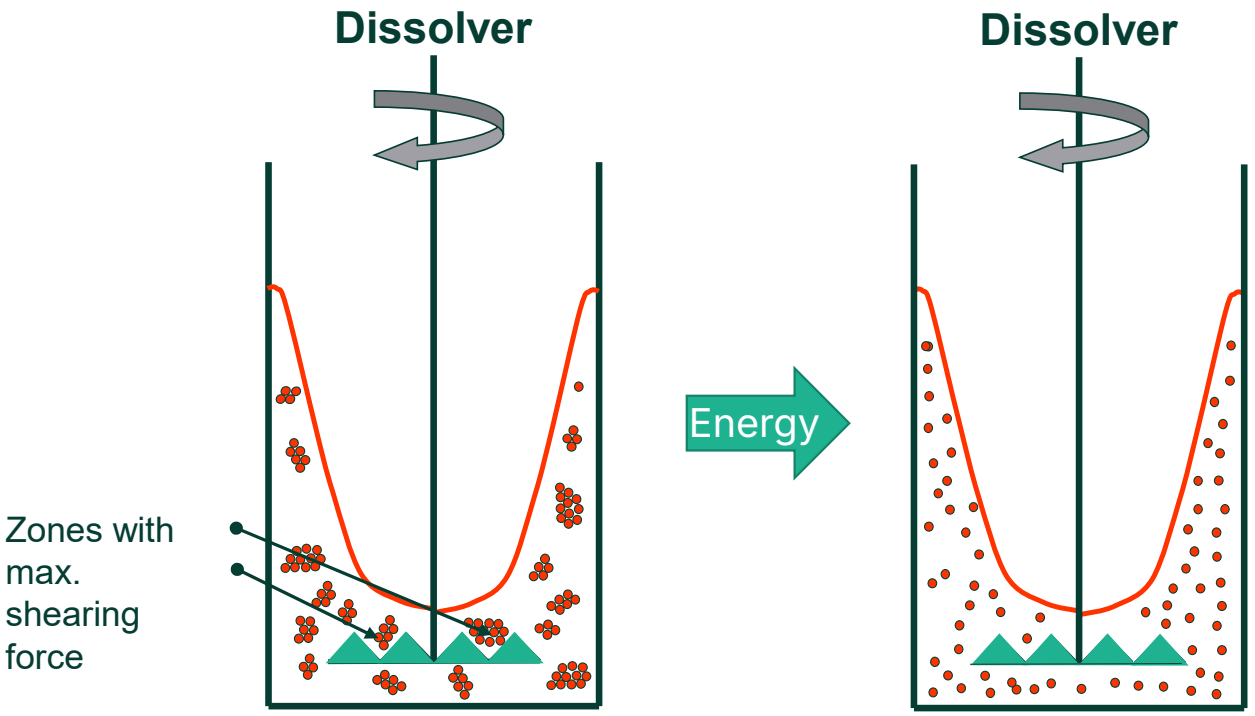


Ideal dispersion

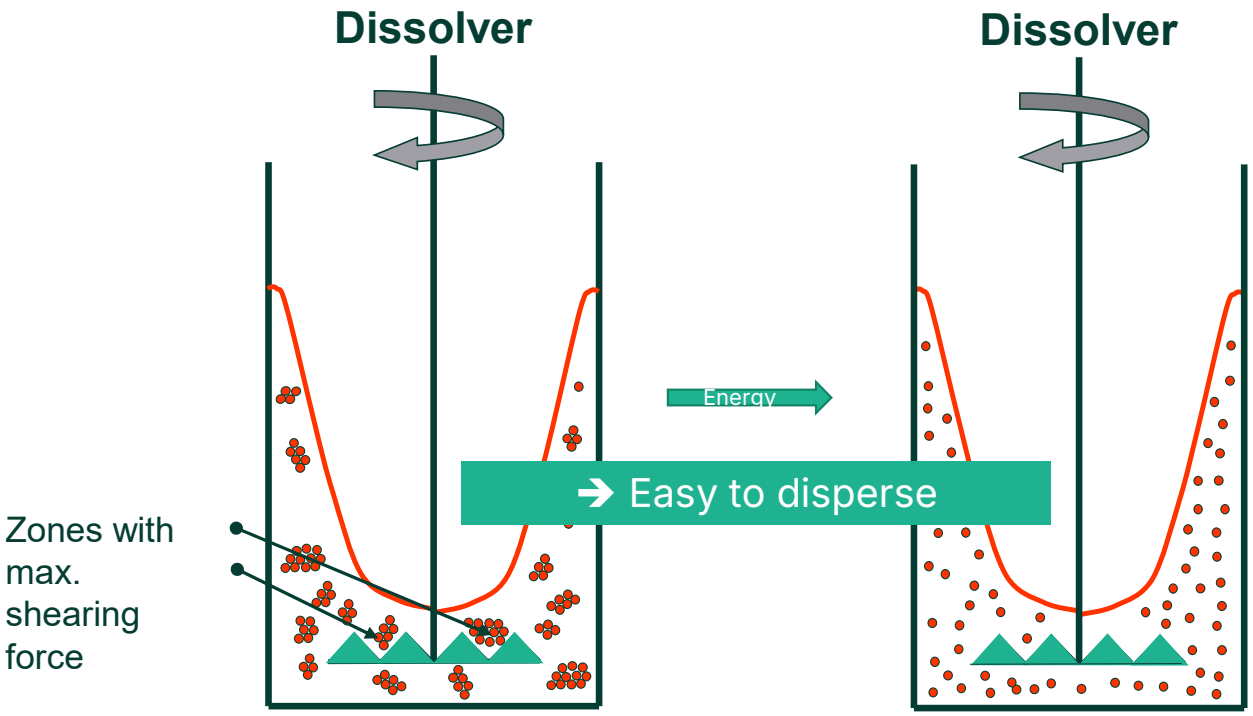
White reductions of the dispersed blue pigment at different stages of the dispersing process:



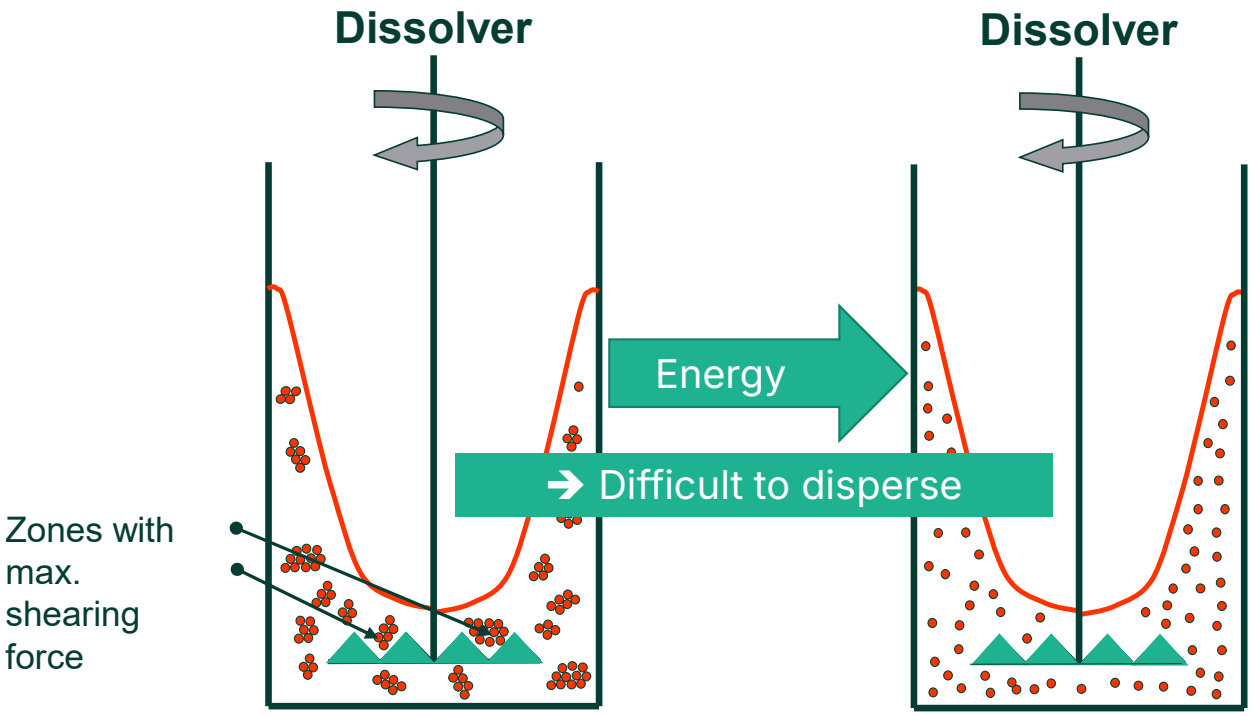
Dispersing with a dissolver



Dispersing with a dissolver



Dispersing with a dissolver



Types of Dispersing Equipment

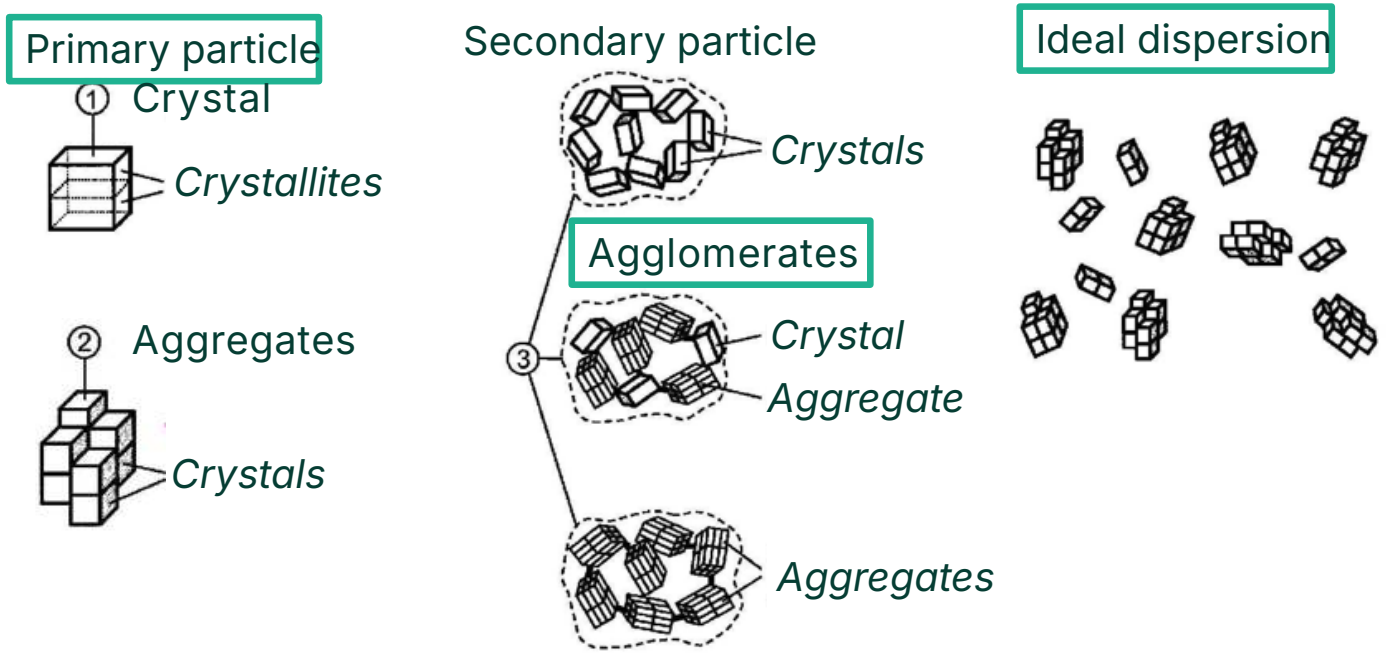
- Media Mills
  - Horizontal
  - Vertical
  - Basket
- 3 Roll Mills
- Can be used in combination

Horizontal media mill

Courtesy of Buhler

3 roll mill

The pigment model (DIN 53206)

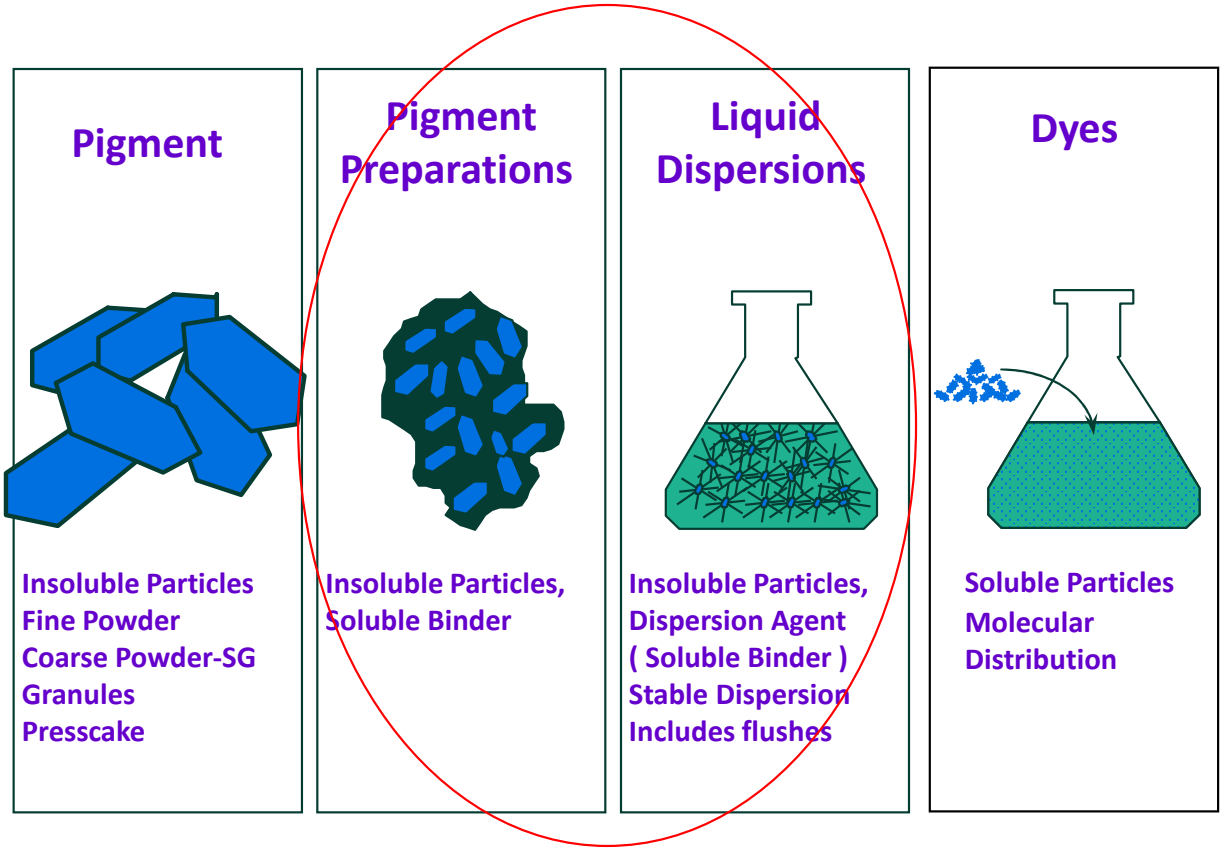


How do properties of organic and inorganic pigments relate to particle size?

Property	Organic 	Inorganic 
Particle size		
Transparency	☺	☹
Opacity	☹	☺
Color strength	☺	☹
Chroma	☺	☹
Fastness properties	😐	☺
Dispersibility	😐	☺

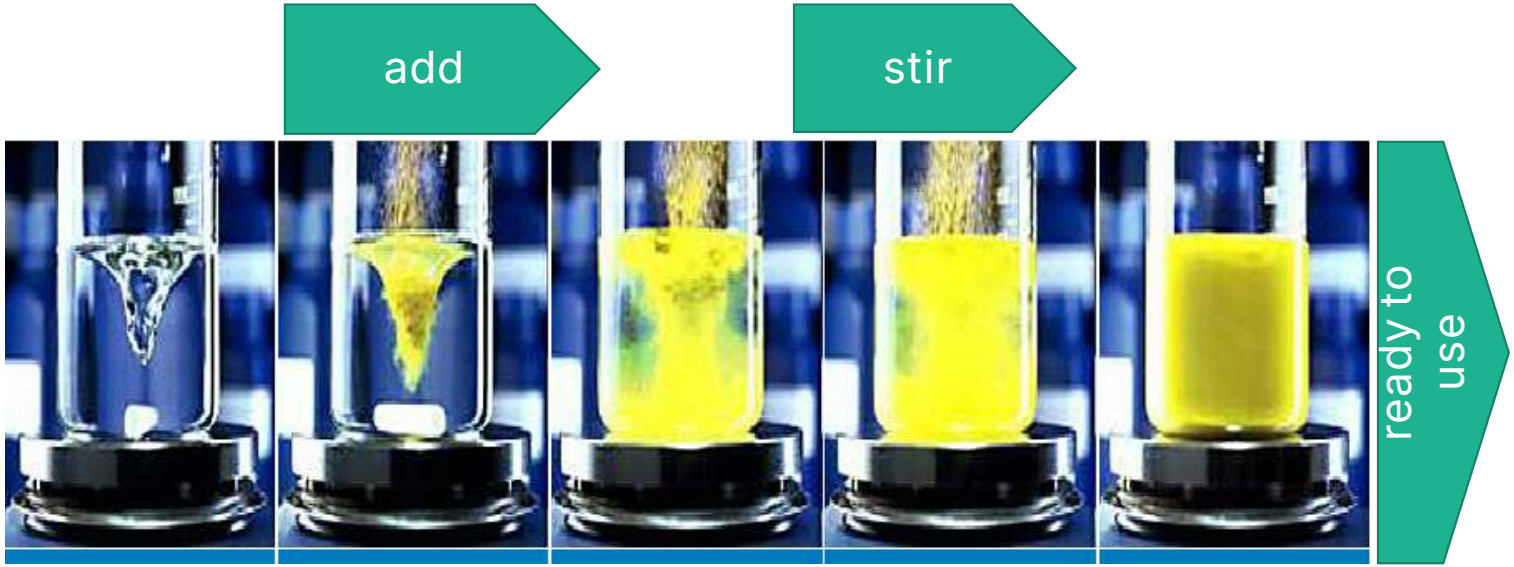
Pigment Preparations

Product Forms



What are pigment preparations?

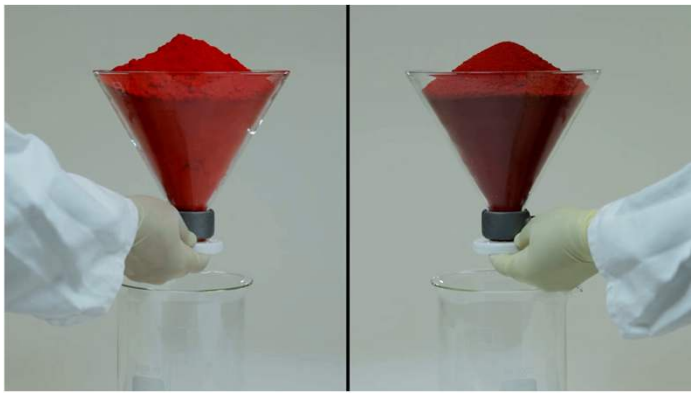
- Pigment preparations are pre-dispersed pigments in solid or liquid delivery form
- Normally, pigment preparations are mono-pigmented



Properties of preparations

- Non-dusting
- Easy to dose
- Easy and quick incorporation
- Fast achievement of color strength and chroma

Dry Pigment Preparation



Benefits of Preparations

- High efficiency
- High quality and reproducibility
- Reduction of dispersion issues
- No color adjustment necessary
- Excellent correlation between lab and production
- Fast color changes possible
- No grinding equipment needed
- Cost reduction in production

Key takeaways for ink formulators

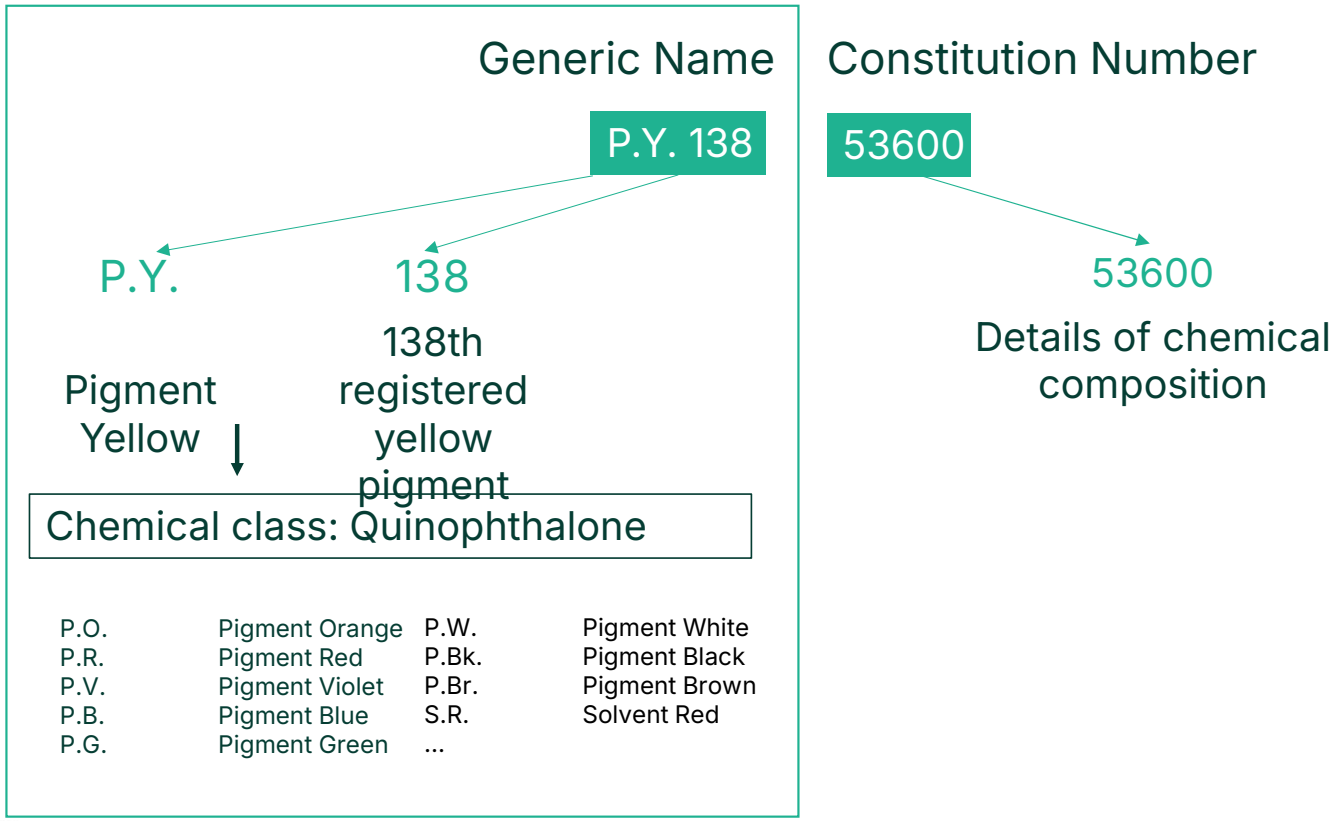
What if you are asked to develop an ink?

- What questions do you ask?
- How do you choose a pigment from hundreds or thousands of choices?
- What do you need to consider?

Initial questions

- What Color Index?
- Color space?
- Weather and lightfastness requirements?
- Regulatory requirements?
  - PAA (Primary Aromatic Amines)
  - Heavy metals
- What type of ink system?
- What type of printing process?

What is Color Index?



Initial questions

- What Color Index?
- Color space?
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  - PAA (Primary Aromatic Amines)
  - Heavy metals
- What type of ink system?
- What type of printing process?

C.I.Pigment Violet 19

Cinquasia Red L4100 HD

Cinquasia Violet L5120

Mass Tone

Initial questions

- What Color Index?
- Color space?
- Weather and lightfastness requirements?
- Regulatory requirements?
  - PAA (Primary Aromatic Amines)
  - Heavy metals
- What type of ink system?
- What type of printing process?

Printing Overview

	Gravure	Flexo	Lithography	Screen	Digital
Typical Print Speeds	**Up to 600 m/min**	**~ 450 m/min**	**600-700 (heatset) 15000-18000 iph (SF)**	**100 m/min (rotary)**	**30-100 m/min (state of art)**
Typical Ink Viscosities	**20-25 secs Zahn 2 0.05 – 0.2 Pa.s**	**20-25 secs Zahn 2 0.05 – 0.5 Pa.s**	**40-100 Pa.s**	**1 – 5 Pa.s (flatbed) Lower for rotary**	**6-15 mPa.s solvent/UV 2-5 mPa.s aqueous**
Typical Wet Film Thickness (µm)	**7 – 15**	**3 – 7**	**0.5 – 2**	**8 – 30**	**6 – 12 (multiple passes)**
Typical Particle Size	**< 8µm**	**< 4µm**	**< 4µm**	**-**	**Mean of 0.05 – 0.2µm Max. of 0.5 – 1.0µm**
Main Binders	**Nitrocellulose, Cellulose Acetate Proprionate, Polyvinyl butyral, Polyamide, Polyurethane, Polyvinyl,** Acrylics, Acrylated Oligomers	**Nitrocellulose, Cellulose Acetate Proprionate, Polyvinyl butyral, Polyamide, Polyurethane, polyvinyl,** Acrylics, Acrylated Oligomers	**Modified rosin esters (phenolic), Hydrocarbons, Drying oils (linseed oil, alkyds)** Acylated Oligomers	**Polyvinyls, Plastisol,** Acrylated Oligomers	**Polyvinyl, nitrocellulose,** Acrylated Oligomers
Main Solvents	**Alcohols (ethanol, n-propanol), Esters (ethyl acetate, n-propyl acetate), glycol retarders (ethoxy propanol),** Water **Ketones,** Acrylated Monomers	**Alcohols (ethanol, n-propanol), Esters (ethyl acetate, n-propyl acetate), glycol retarders (ethoxy propanol),** Water **Ketones,** Acrylated Monomers	**Petroleum distillates (heatset inks, 260-290°C), Mineral oils, Vegetable Oils (linsed, soya, rapeseed etc)** Acrylated Monomers	**Glycols,** Acrylated Monomers	**Water, Glycols, esters, ketones,** Acrylated Monomers

Initial questions

- What Colour Index?
- Color space?
- Weather and lightfastness requirements?
- Regulatory requirements?
  - PAA (Primary Aromatic Amines)
  - Heavy metals
- What type of ink system?
- What type of printing process?

From the Pigment Technical Data Sheet…

- Surface area
- Oil Absorption
- Colour Index
- Suitability for use in target system
  - Water
  - Solvent
  - UV

Final Thoughts

- Remember, as an ink formulator, you are providing color (not ink) to your customer!
- There may be many ways to achieve the same result.
- Color Index only denotes chemistry; it says nothing about surface treatments, primary particle size, etc.
  - Those things can impact your ink formulation!
- Questions? Reach out to your supplier; they are there to help you!
- Interested in synthesis, processing, etc?
  - See “Industrial Organic Pigments Production, Properties and Applications” Herbst and Hunger

QUESTIONS?

Will anyone be attending Printing Untied Expo in Las Vegas September 23-25th?

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- Micro Titanium Dioxide

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- Soy Lecithin

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- Styrene Butadiene Latex
- Styrene Acrylic Latex
- Vinyl Acrylic Latex

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