



## Polymorphism of Copper Phthalocyanine Pigments

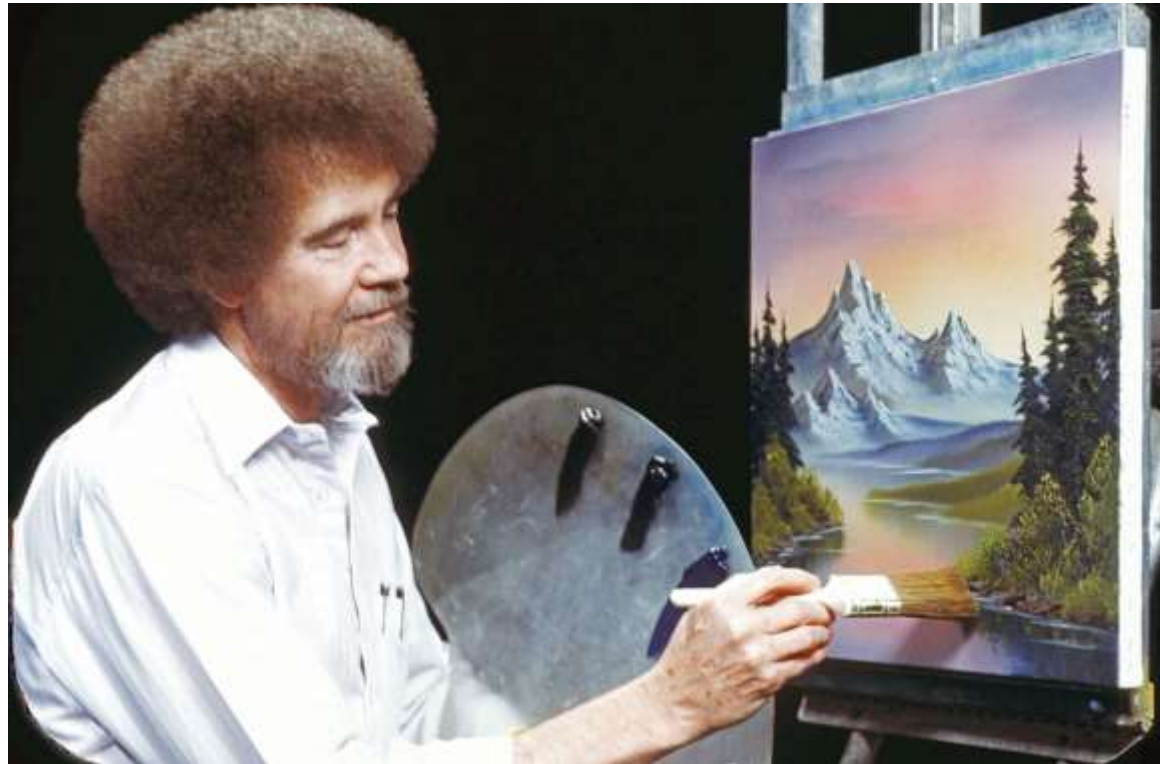
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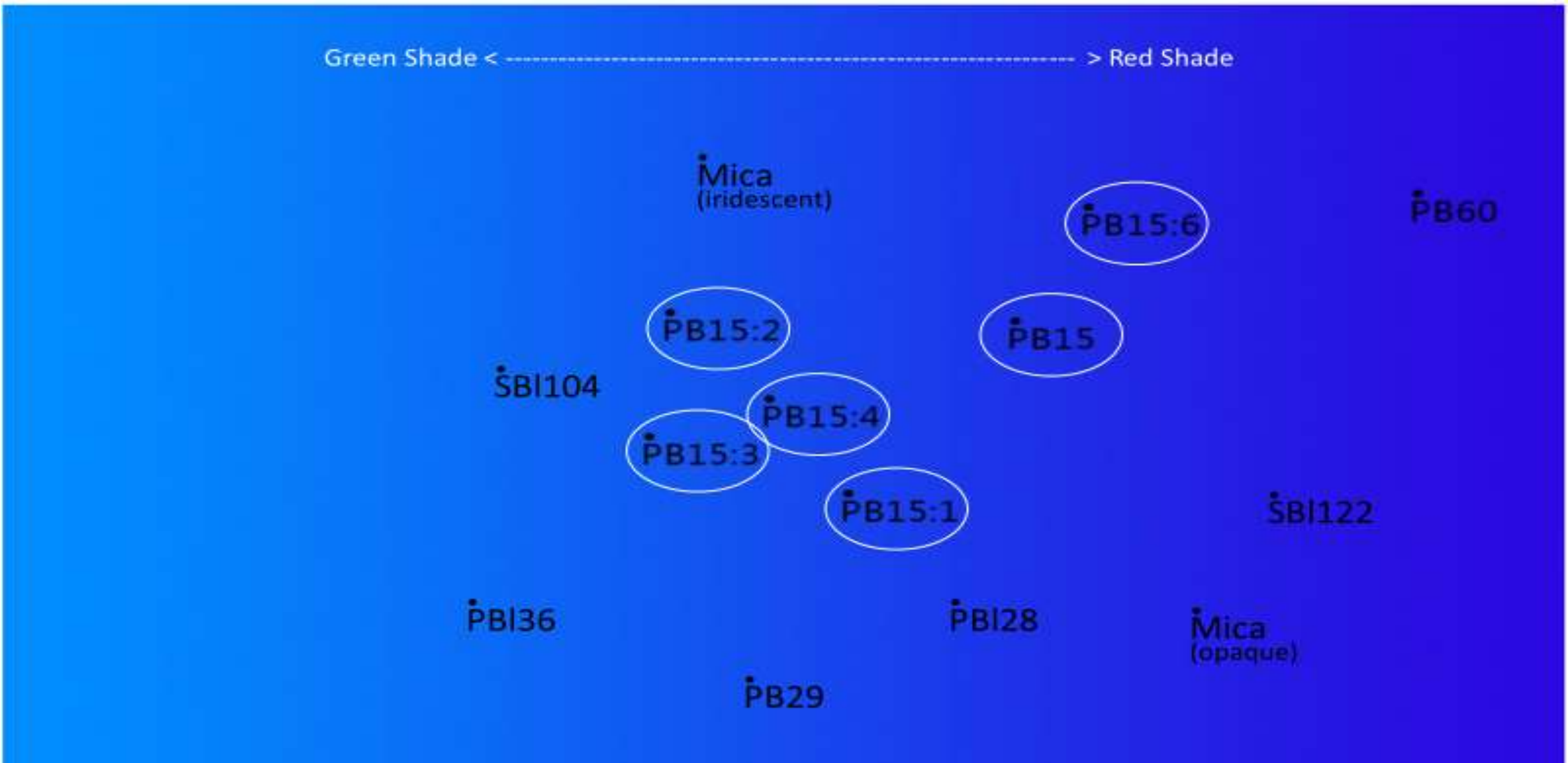
(862) 704-0055

Phthalo blue is a pigment you've seen thousands of times before, but maybe not had a name to put to the color – it's the sea, the sky, and in the case of Bob Ross, snowy accents in paintings.



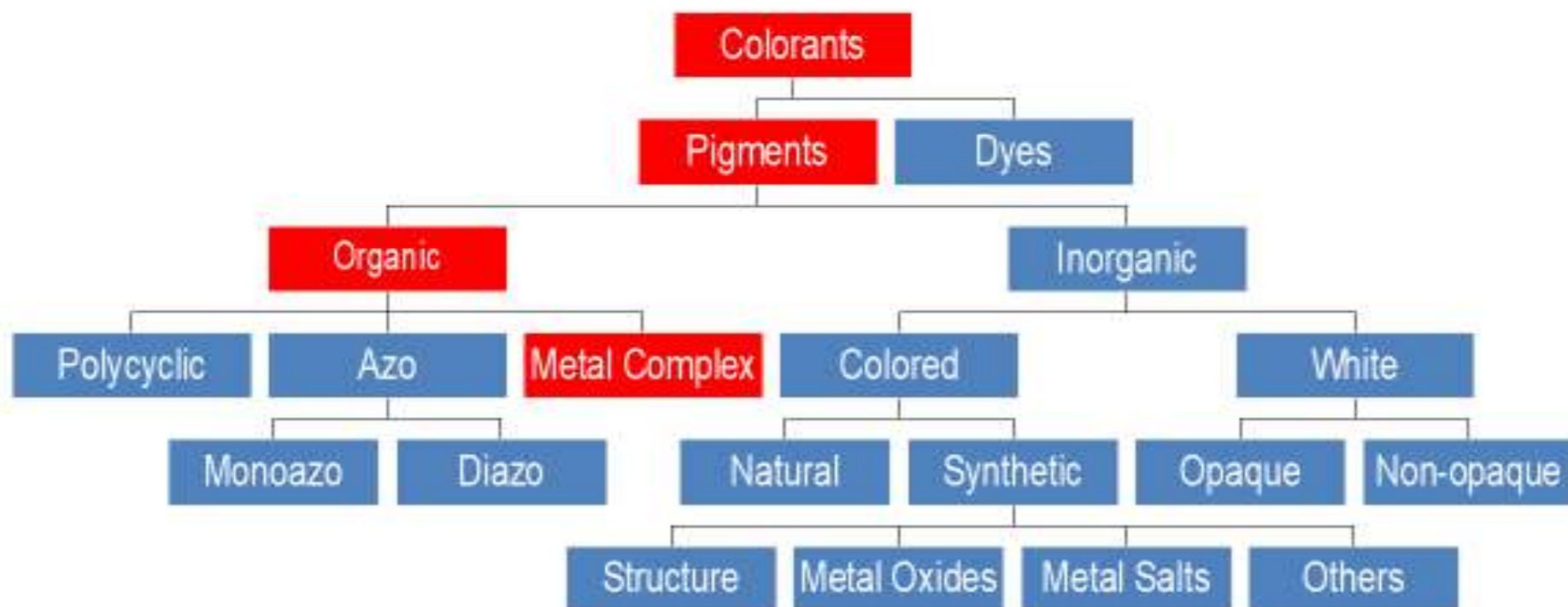
# BLUE Color Space

Green Shade < ----- > Red Shade





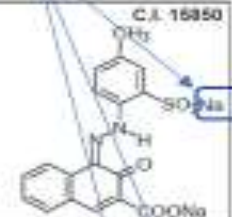
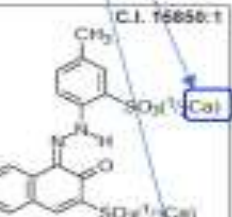
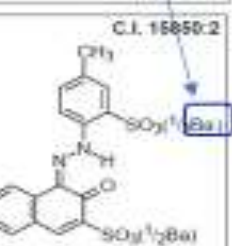
## Pigment Classification



# Pigment Classification

## C.I. distinctions

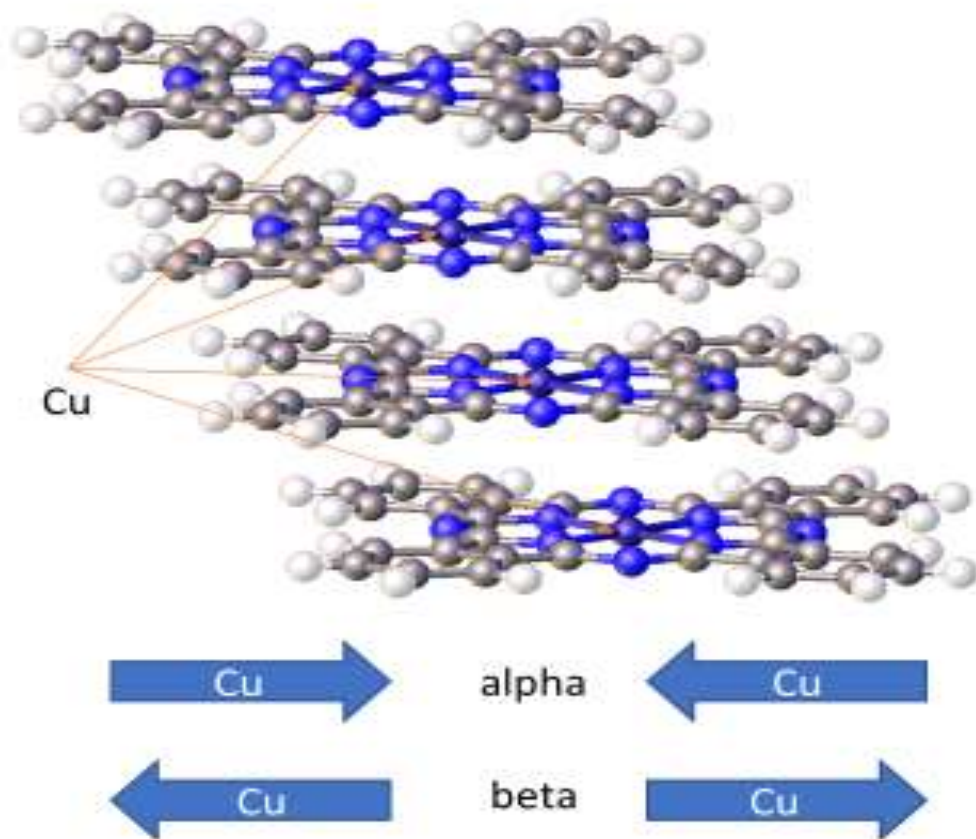
“:” can be chemical or **crystal structure**

<p><b>C.I. Pigment Red 57</b></p> <p><b>Use:</b> Blush red</p> <p><b>Chemical Class:</b> Monazo</p> <p><b>Discoverer:</b> R. Gley and O. Siebert 1903</p> <p><b>First known product:</b> Lithol Rubine (FIAT)</p> <p><b>CAS (see note p. vi):</b> 5858-81-1</p> <p><b>EU No. (see note p. vi):</b> 227-497-9</p>	 <p>C.I. 16850</p> <p>SO<sub>3</sub><sup>-</sup>Na</p> <p>COONa</p>
<p><b>C.I. Pigment Red 57:1</b></p> <p><b>Use:</b> Red (not pale reddish violet)</p> <p><b>Chemical Class:</b> Monazo</p> <p><b>Discoverer:</b> R. Gley and O. Siebert 1903</p> <p><b>First known product:</b> Lithol Rubine (FIAT)</p> <p><b>CAS (see note p. vi):</b> 5201-04-9</p> <p><b>EU No. (see note p. vi):</b> 226-106-5</p>	 <p>C.I. 16850:1</p> <p>CH<sub>3</sub></p> <p>SO<sub>3</sub><sup>-</sup>(<sup>1/2</sup>Co)</p> <p>SO<sub>3</sub><sup>-</sup>(<sup>1/2</sup>Ca)</p>
<p><b>C.I. Pigment Red 57:2</b></p> <p><b>Use:</b> Blush red</p> <p><b>Chemical Class:</b> Monazo</p> <p><b>Discoverer:</b> R. Gley and O. Siebert 1903</p> <p><b>CAS (see note p. vi):</b> 17552-98-1</p> <p><b>EU No. (see note p. vi):</b> 241-826-4</p>	 <p>C.I. 16850:2</p> <p>CH<sub>3</sub></p> <p>SO<sub>3</sub><sup>-</sup>(<sup>1/2</sup>Ba)</p> <p>SO<sub>3</sub><sup>-</sup>(<sup>1/2</sup>Ba)</p>

## Polymorphism - Crystal Modifications

- Many organic pigments from different chemical classes are polymorphous - they occur in more than one modification or crystal structure.
- The copper phthalocyanine blue is one example of a polymorphic pigment. This pigment occurs in many different forms -  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\epsilon$ ,  $\delta$ ,  $\pi$ ,  $\chi$ ,  $\rho$
- The alpha ( $\alpha$ ) and beta ( $\beta$ ) forms have the most commercial importance.

## Polymorphism - Crystal Modifications



The amount of overlap and thus the Cu-Cu spacing determines the form of the CPC.

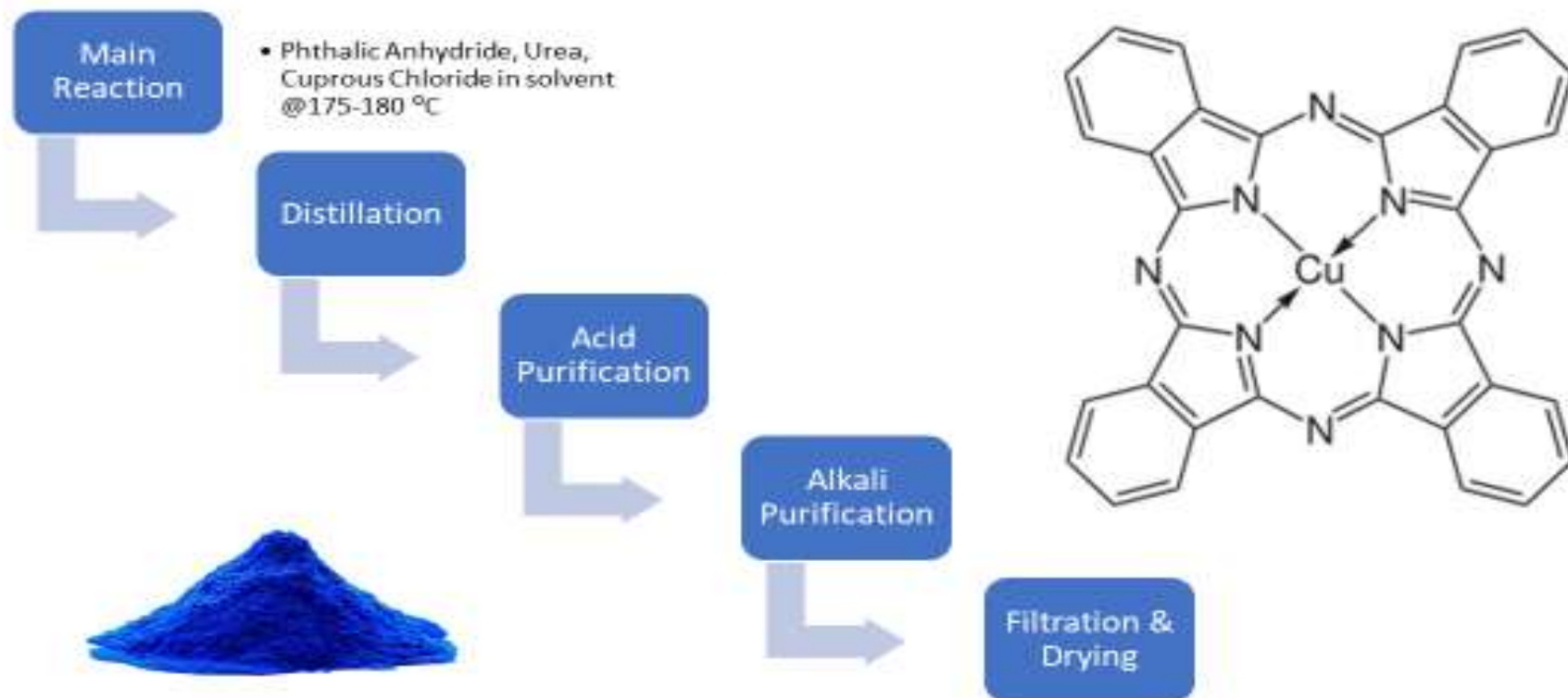
**More overlap** – smaller Cu-Cu spacing ( $\sim 3.8 \text{ \AA}$ ) – are the  **$\alpha$  phase**

- PB15:0 (or PB15)
- PB15:1
- PB15:2

**Less overlap** – larger Cu-Cu spacing ( $\sim 4.8 \text{ \AA}$ ) – are the  **$\beta$  phase**

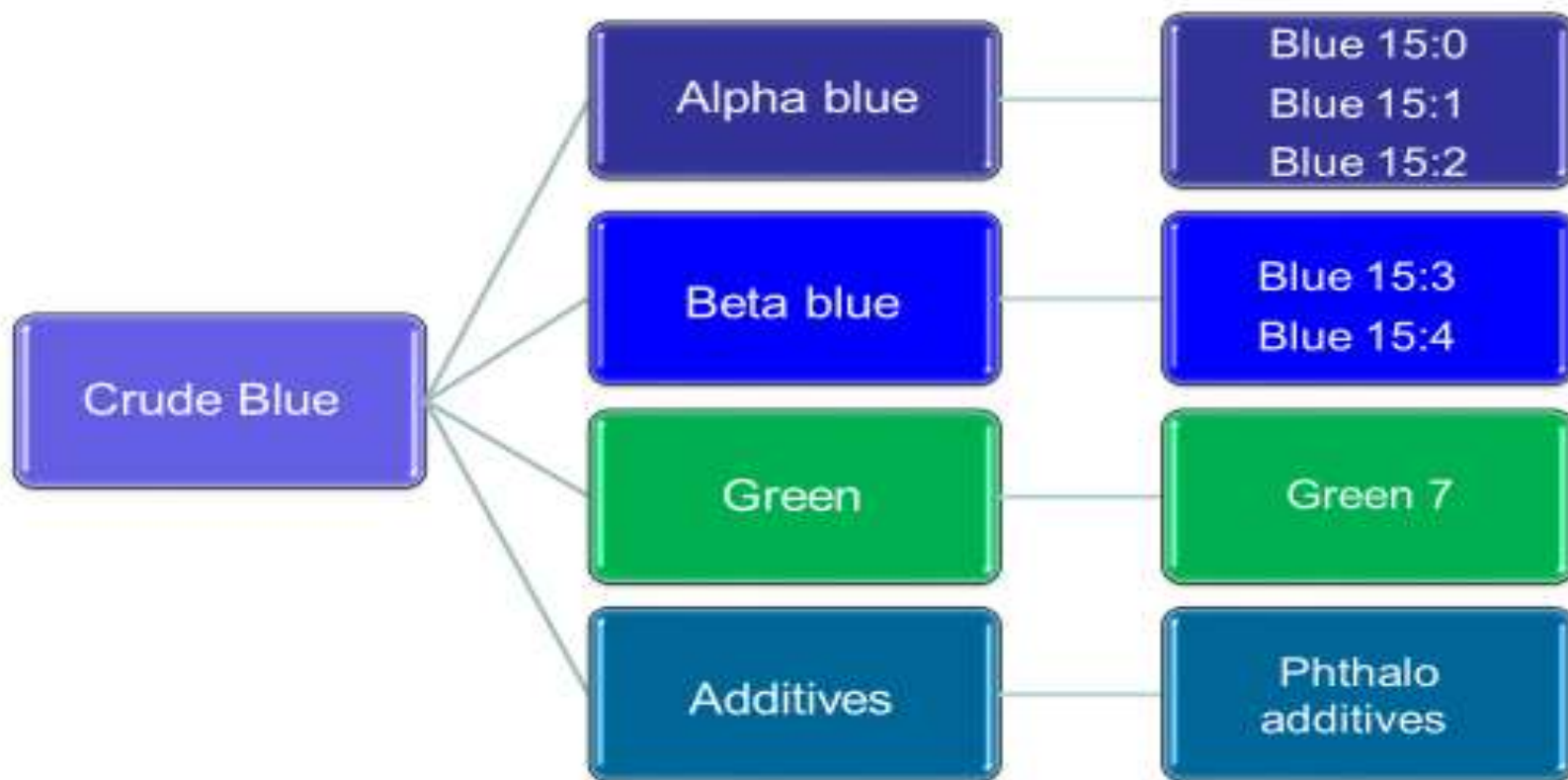
- PB15:3
- PB15:4

## Brief Process- Crude Copper Phthalocyanine

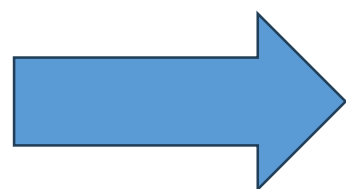




## Copper Phthalocyanine



## Brief Process— Alpha Blue



### Acid Pasting

Crude blue is dissolved in Sulfuric acid.

### Precipitation

Acid pasting slurry is discharged in water to precipitate Alpha blue particles.

### Filtration and Re-slurry

Isolate Alpha blue by filtration and washing. Dispersed the wet cake of Alpha blue in water to form uniform slurry.

### Pigmentation and Surface treatment

Crystal growth and surface treatment as per the required end application.

### Drying, Pulverization

Drying of pigment and pulverize the lumps on suitable mill as per the end application.

## Images of Alpha Copper Phthalocyanine

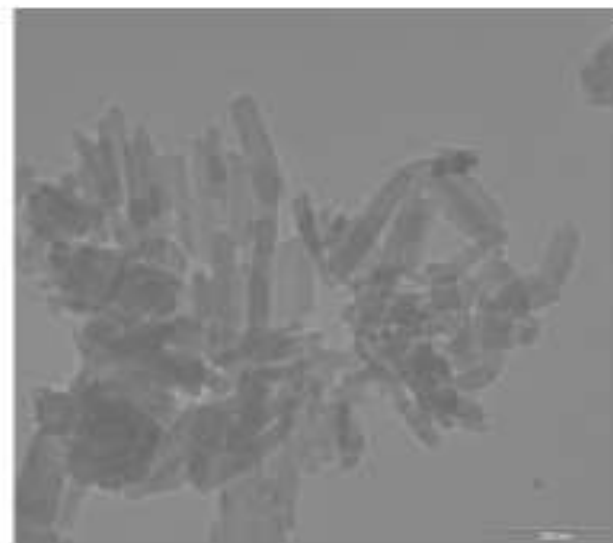
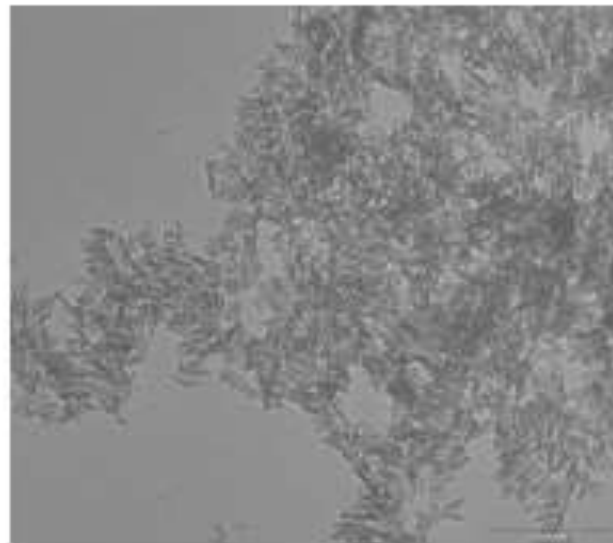
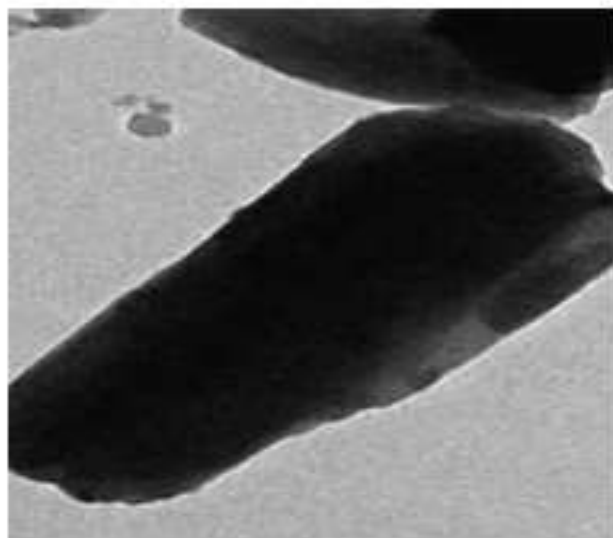
**Crude copper  
phthalocyanine**



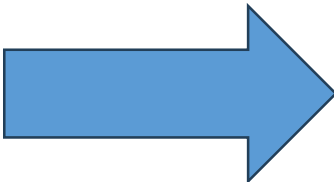
**Precipitation**



**Pigmentation**



## Brief Process – Beta Blue



Particle size reduction of  
Crude blue

Crude blue is milled in ball mill / Attritor to reduced the particle size of crude blue

Pigmentation and Surface  
treatment

Milled crude is processed for crystal growth by using solvent along with surfactant to get desired particle size required for end application.

Distillation

Distilled out solvent by using steam distillation.

Purification and Surface  
treatment

After distillation, slurry is purified and surface treated with surfactant / additive.

Filtration, Drying and  
Pulverization

Drying of pigment and pulverize the lumps on suitable mill as per the end application.

## Images of Beta Copper Phthalocyanine

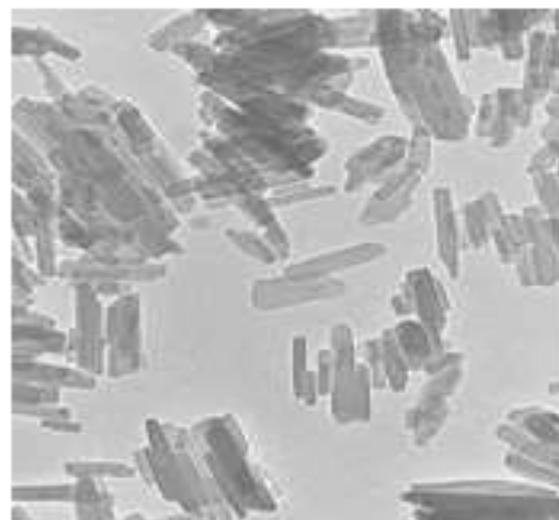
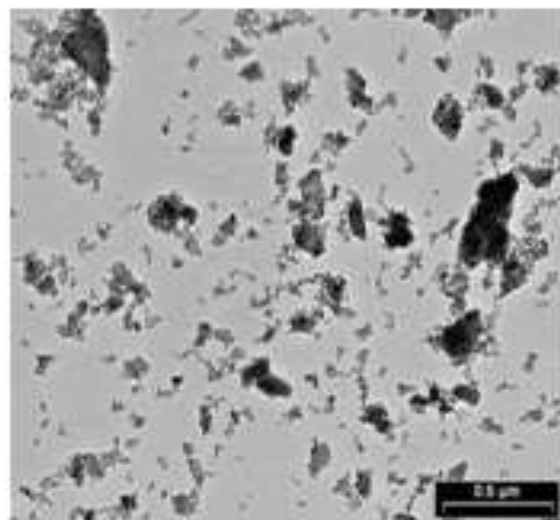
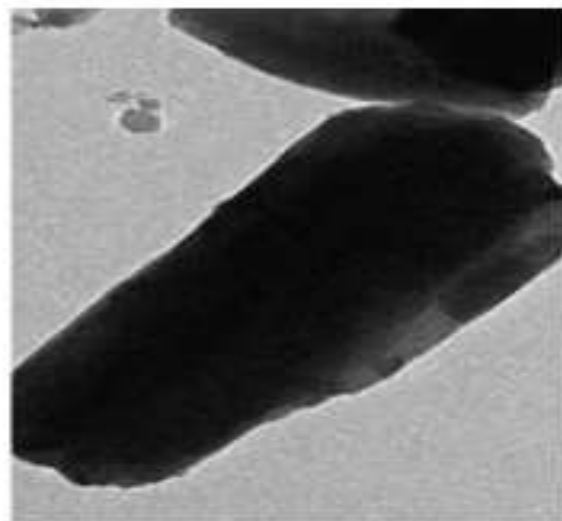
**Crude copper  
phthalocyanine**



**Milling**



**Pigmentation**



# Pigment Synthesis

~75-80%  
of the pigment  
performance

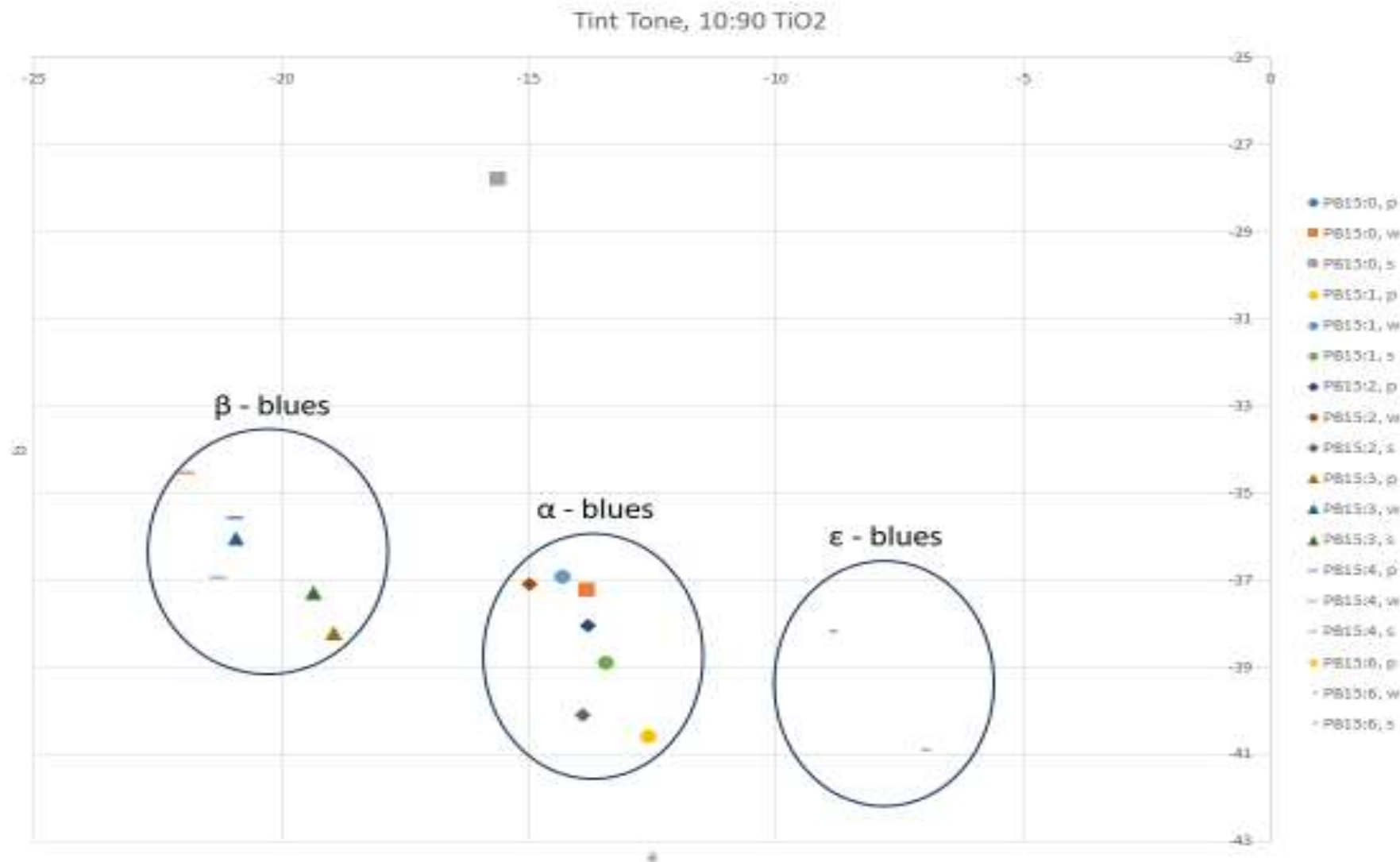
- The first manufacturing step(s) determine the chemical identity of the pigment.
- Crude pigment is the end product of the synthesis.
- Finishing and surface treatment provide the end use properties.



## Role of Phthalo Additive in Phthalocyanine

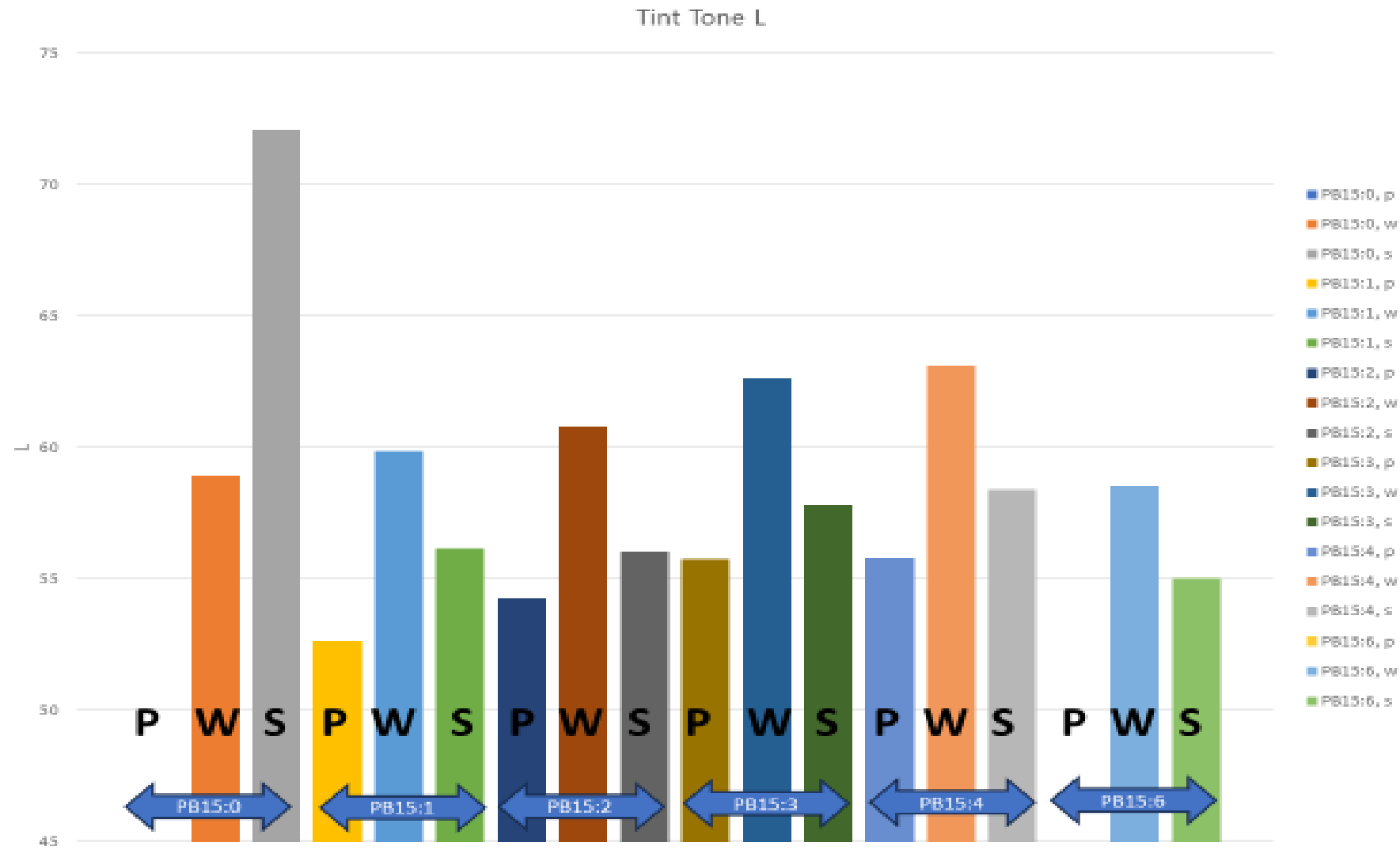
- Regulates crystal growth during synthesis.
- Rheology improvements in inks and coatings.
- Exhibits non crystallizing and non flocculating properties.
- Heat stability for plastic applications.
- Improves dispersibility.

# Color positions – all crystals, all applications





# Color positions – all crystals, all applications

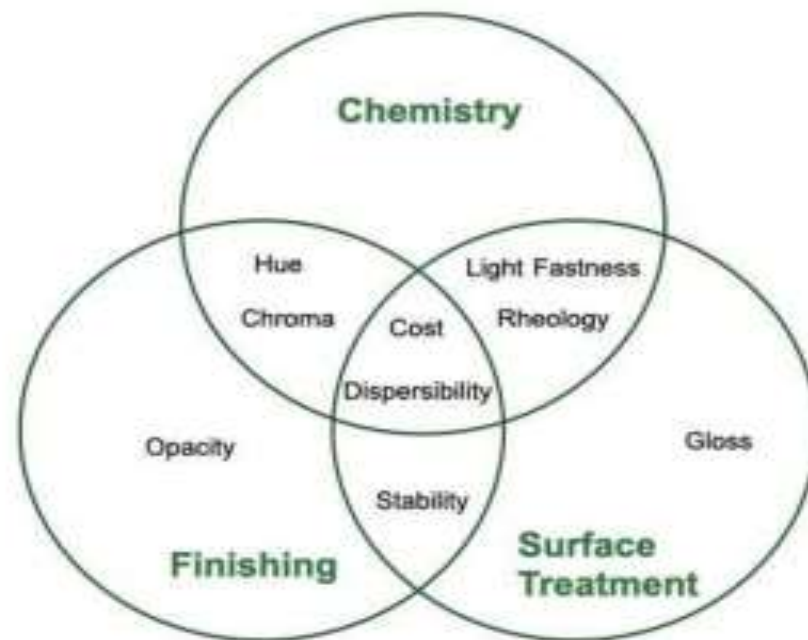


- PB15:0, p
- PB15:0, w
- PB15:0, s
- PB15:1, p
- PB15:1, w
- PB15:1, s
- PB15:2, p
- PB15:2, w
- PB15:2, s
- PB15:3, p
- PB15:3, w
- PB15:3, s
- PB15:4, p
- PB15:4, w
- PB15:4, s
- PB15:6, p
- PB15:6, w
- PB15:6, s

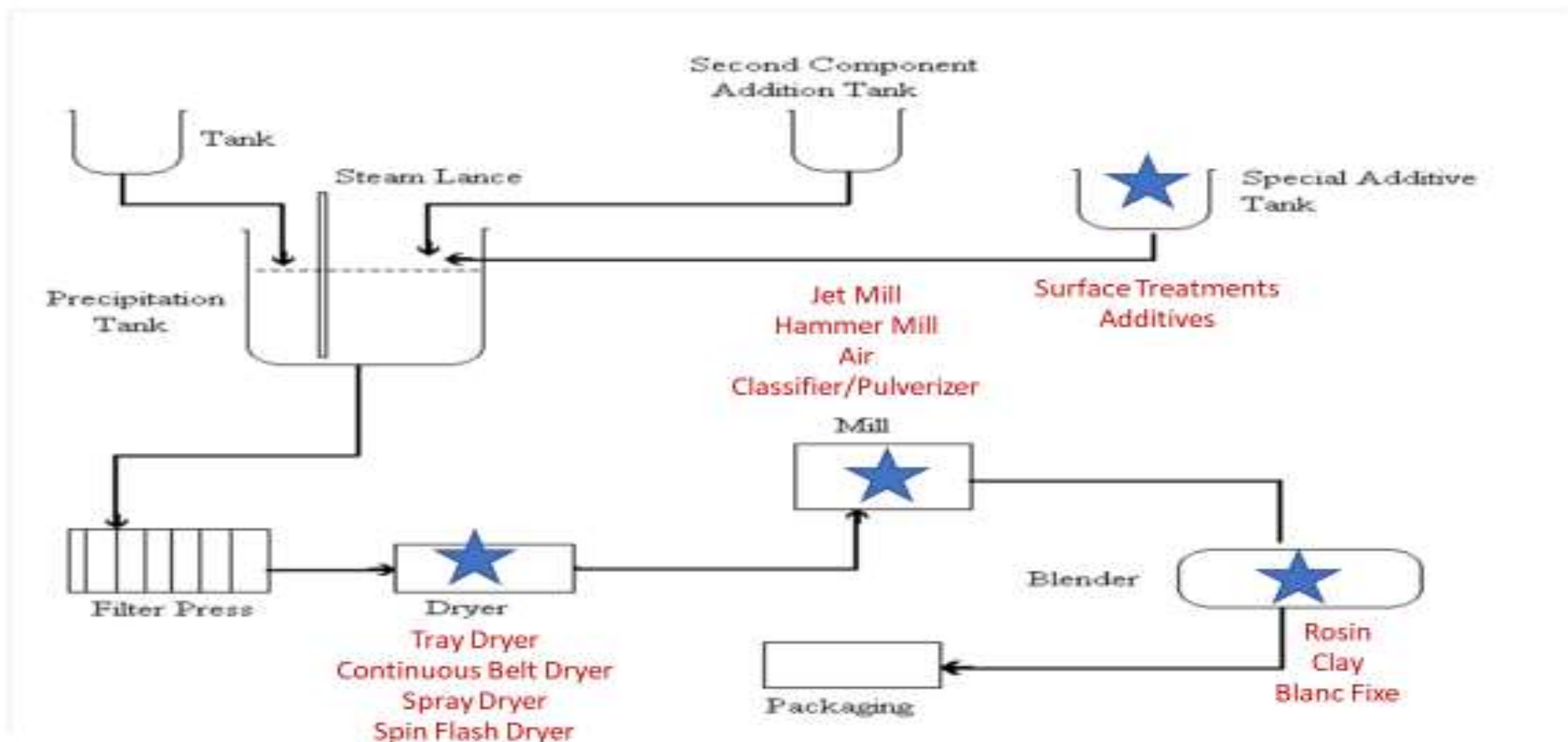
# Pigment Synthesis

~75-80%  
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performance

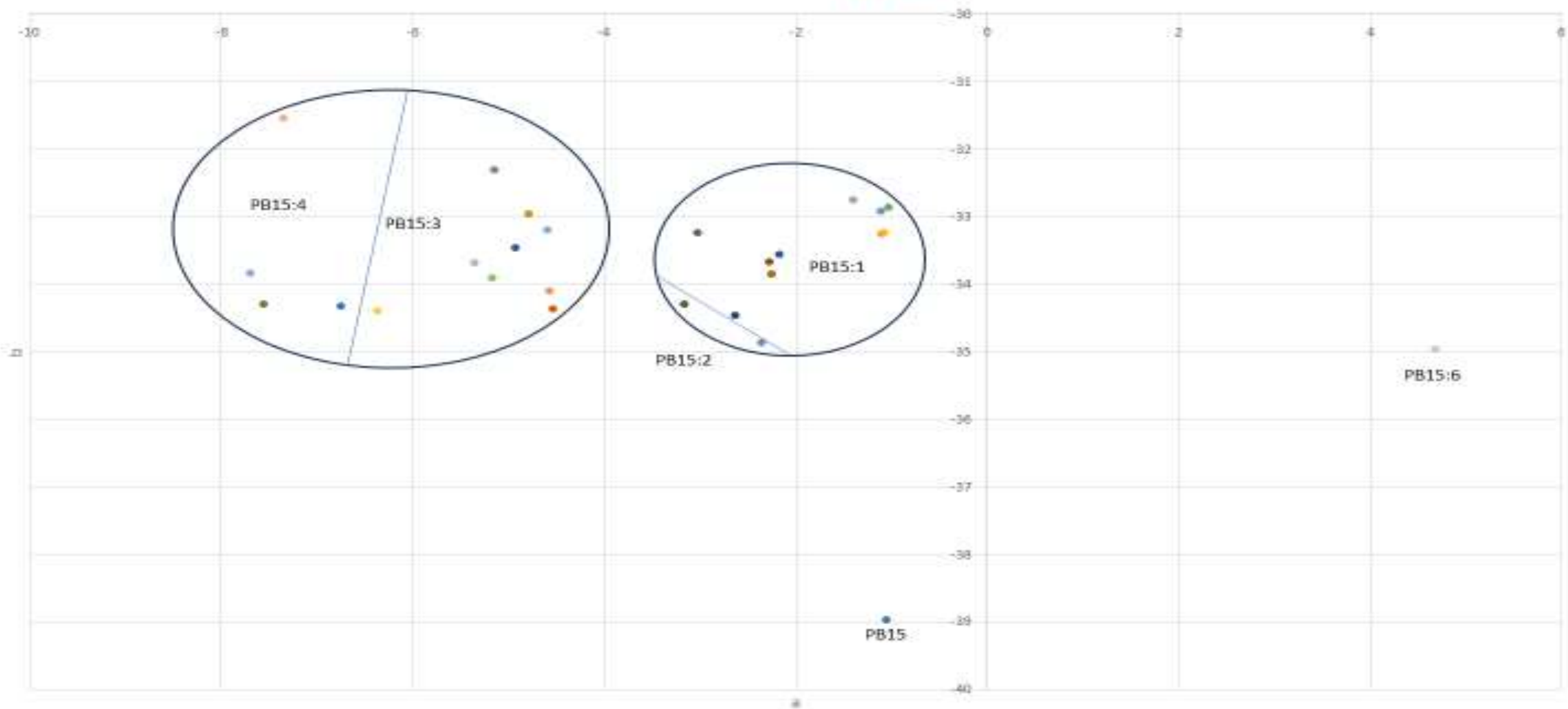
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  - Crude pigment is the end product of the synthesis.
- 
- Finishing and surface treatment provide the end use properties.



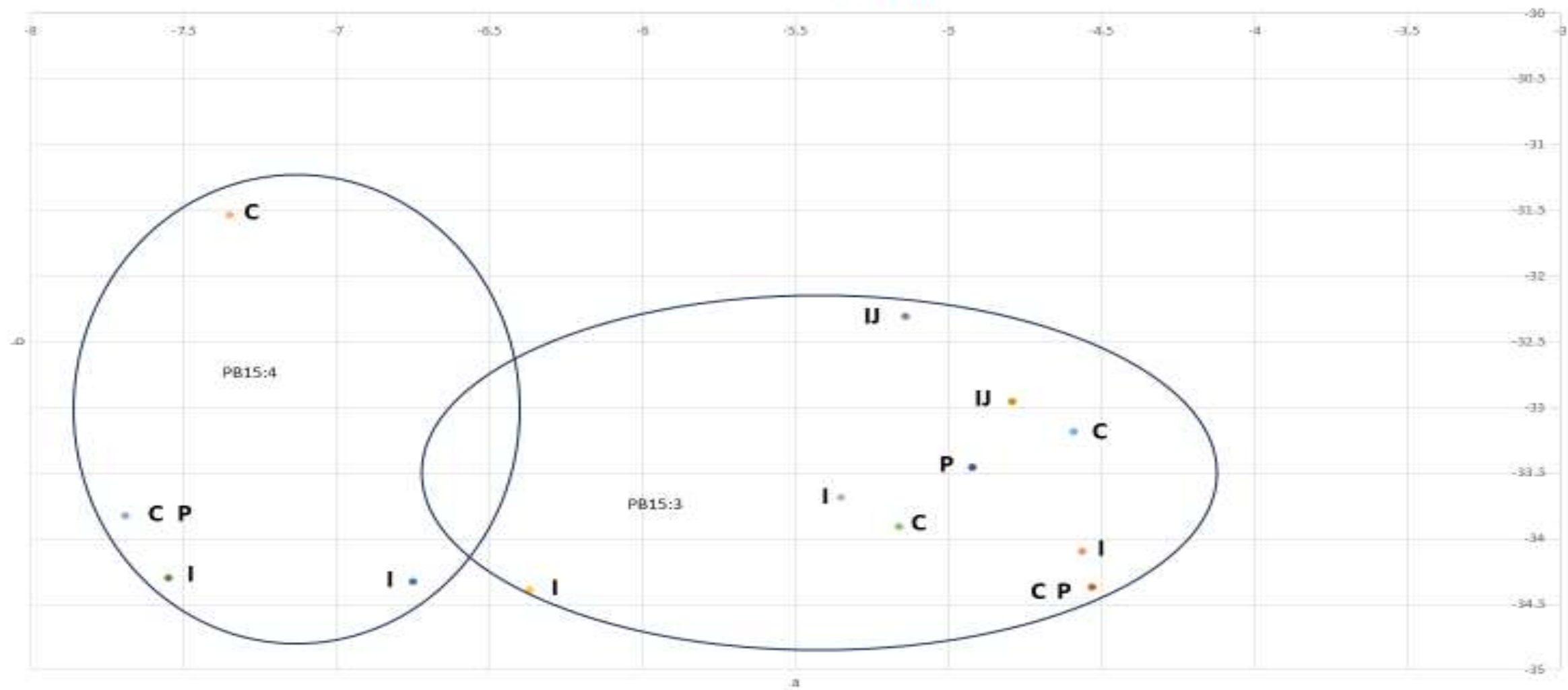
## Finishing Steps – Impact on Application



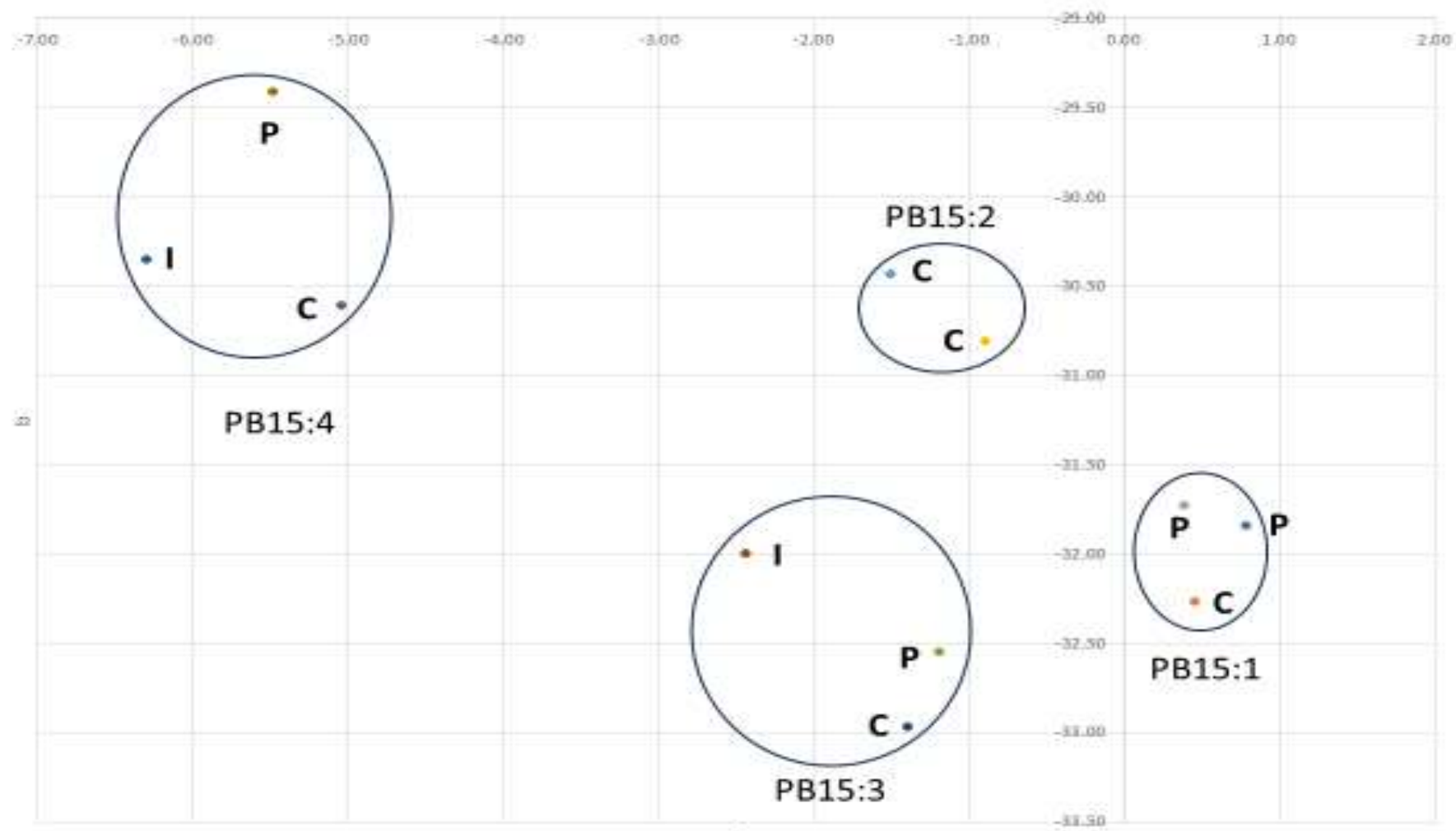
SB PU Deep Tint Tone (1:1 TiO<sub>2</sub>)



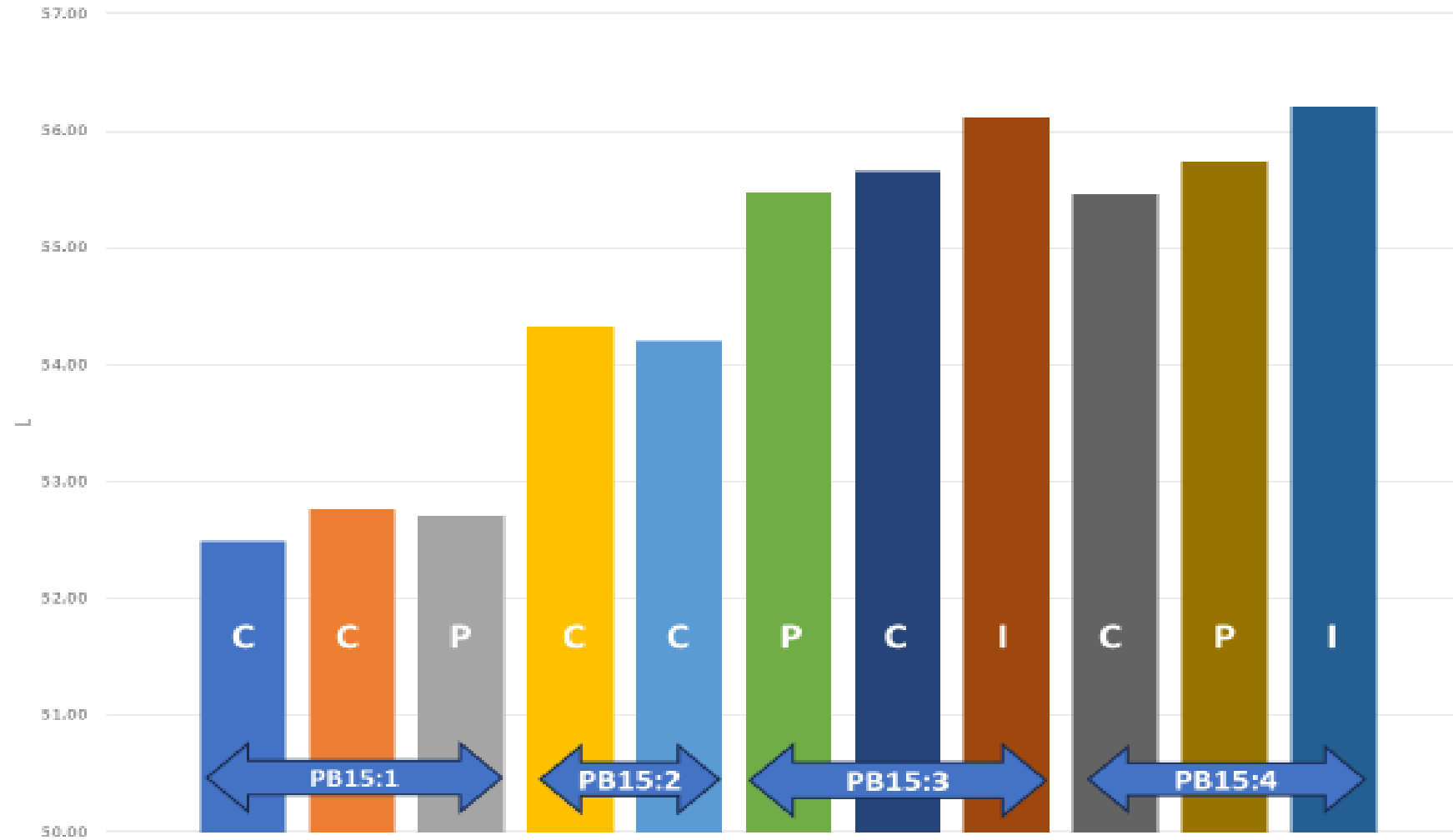
SB PU Deep Tint Tone (1:1 TiO2)



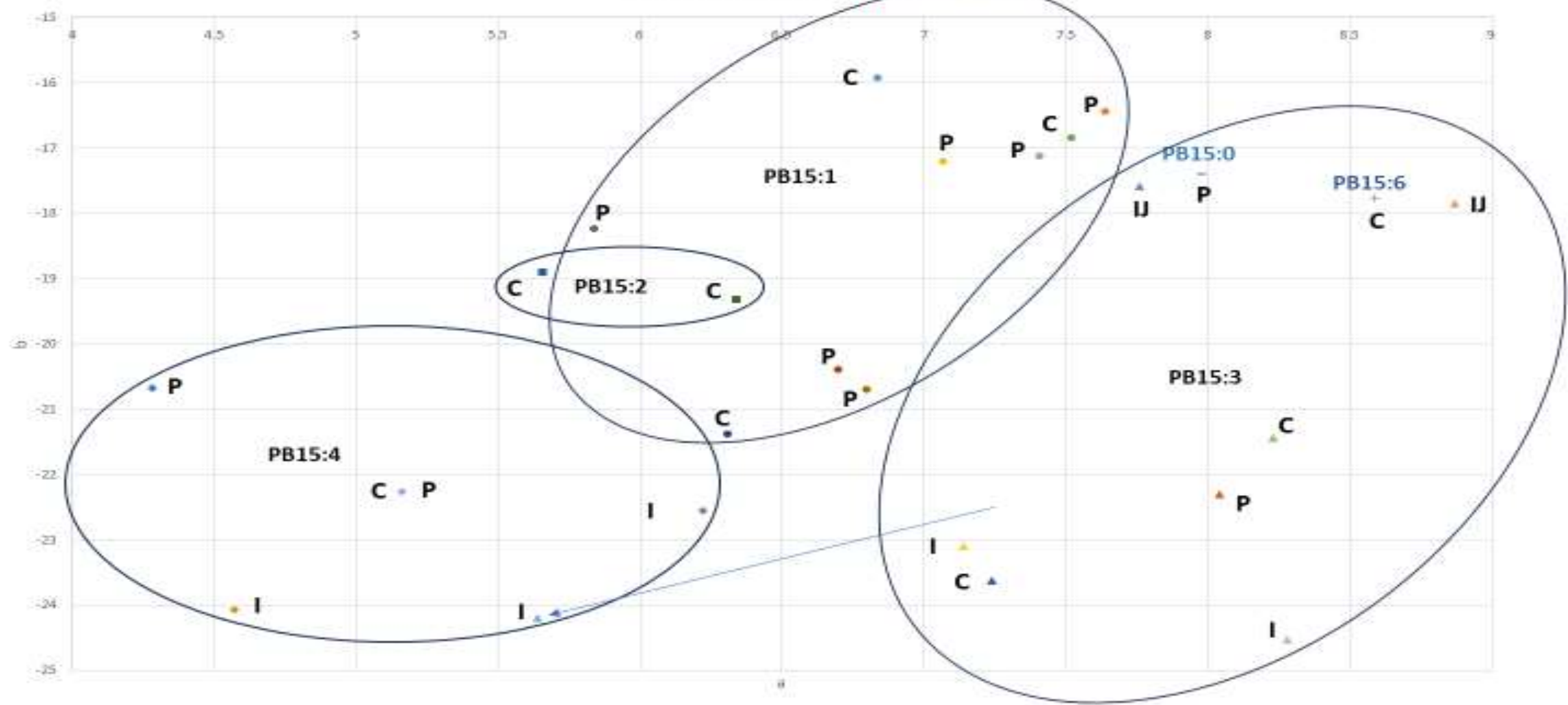
Powder, Deep Tint Tone



Powder, Tint Tone L

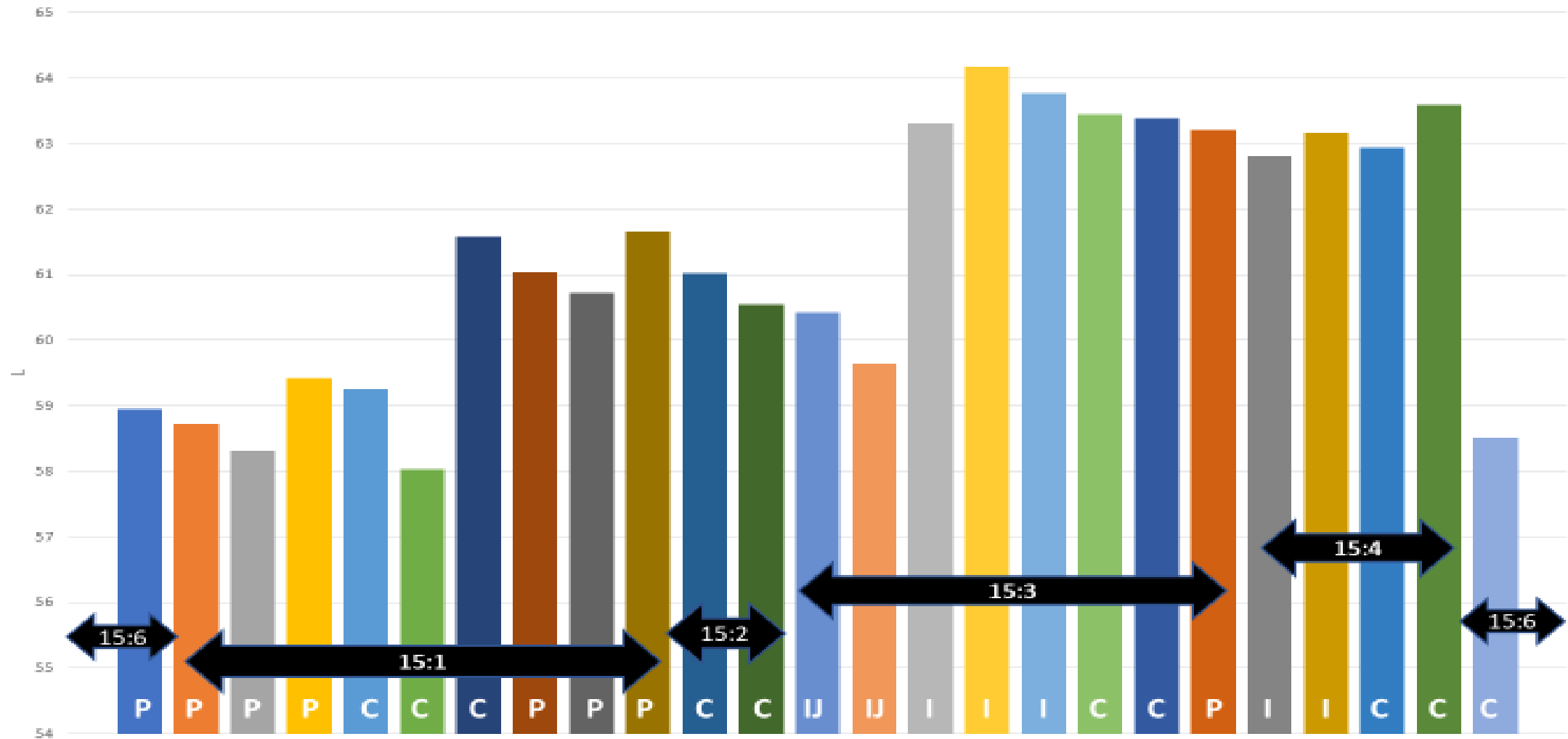


WB Deco Formulation, FT





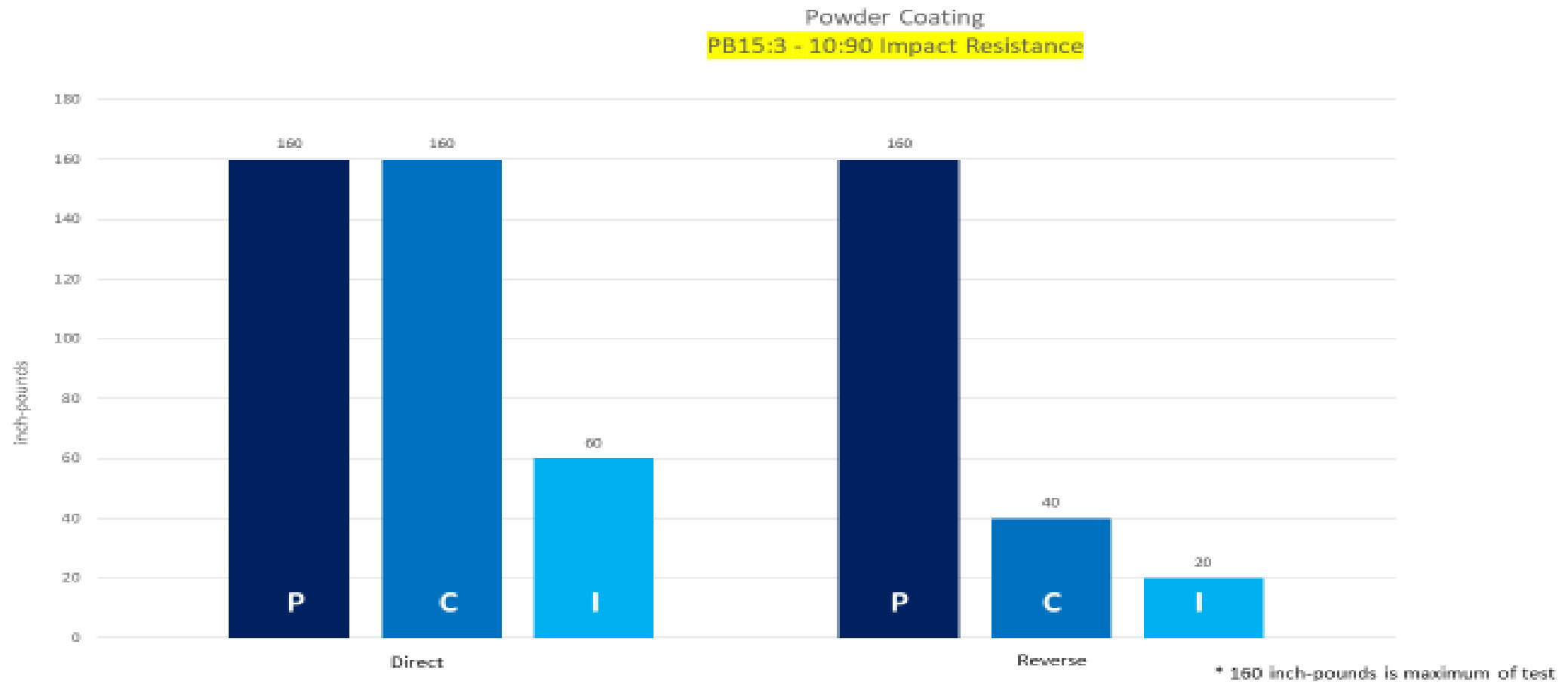
WB Deco Formulation, TT L



Color Development by Application (SB PU vs Powder)



## Finishing Differences – PB15:3 (Plastic, Coating, Ink)

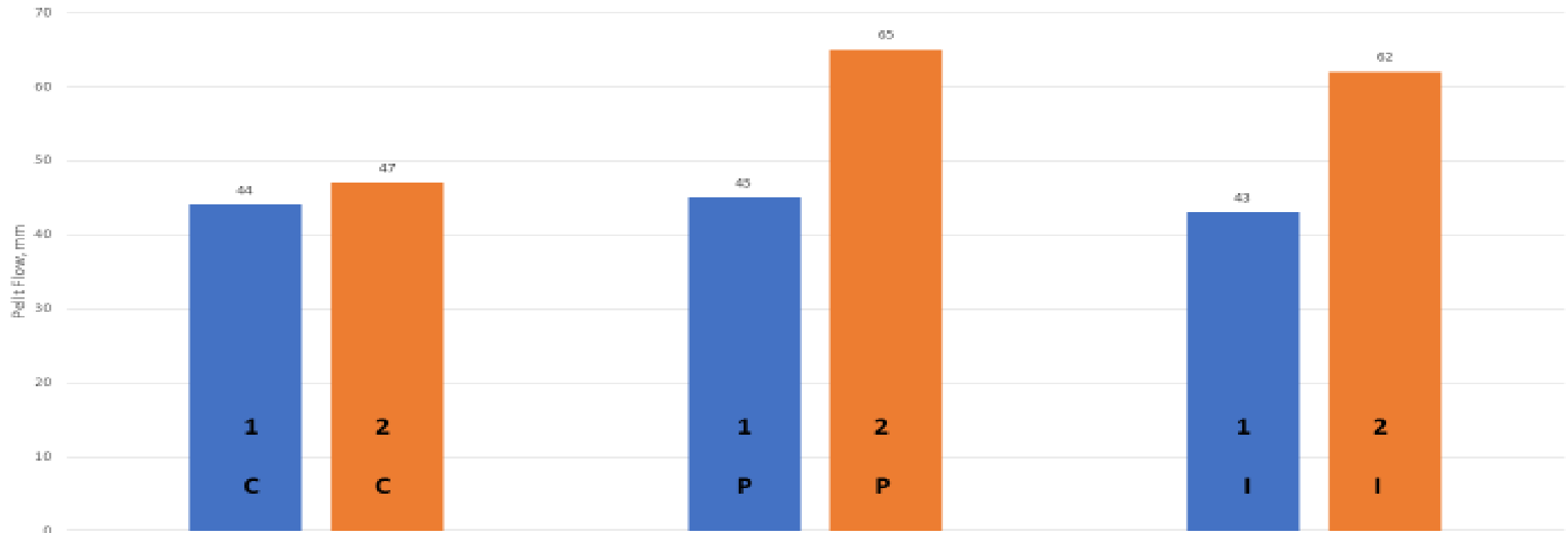


## Resin Chemistry Differences Finishing Differences

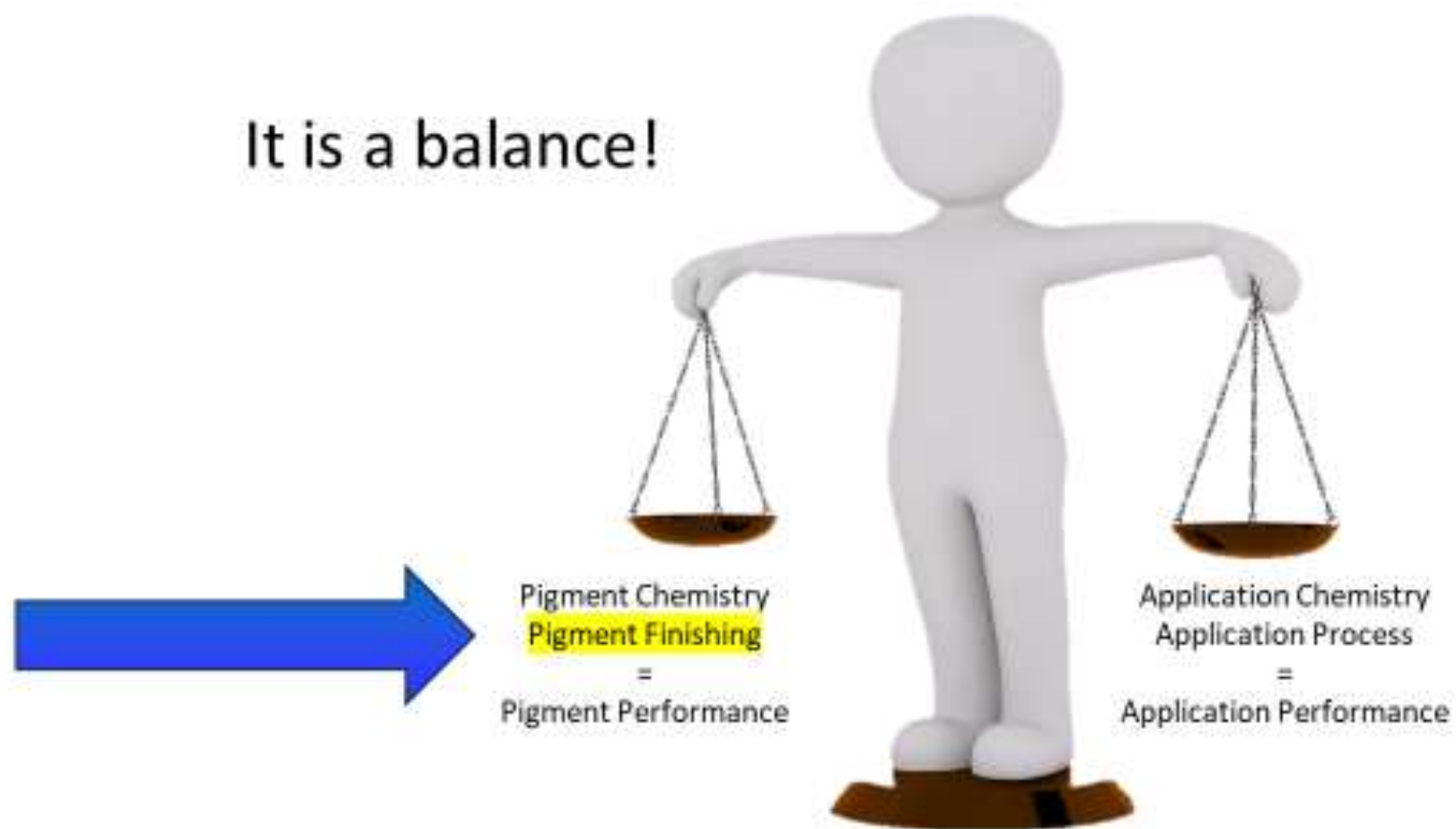
- 1 – polyester
- 2 – acrylic-epoxy hybrid

PB15:4 Powder Coating - 50:50 TiO<sub>2</sub>

Pellet Flow, mm



It is a balance!



MUST's

WANT's

NICE TO HAVE's



# Questions?

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