



The Higher the Better? What Does Zeta Potential Tell About Design of Wetting and Dispersing Additives?

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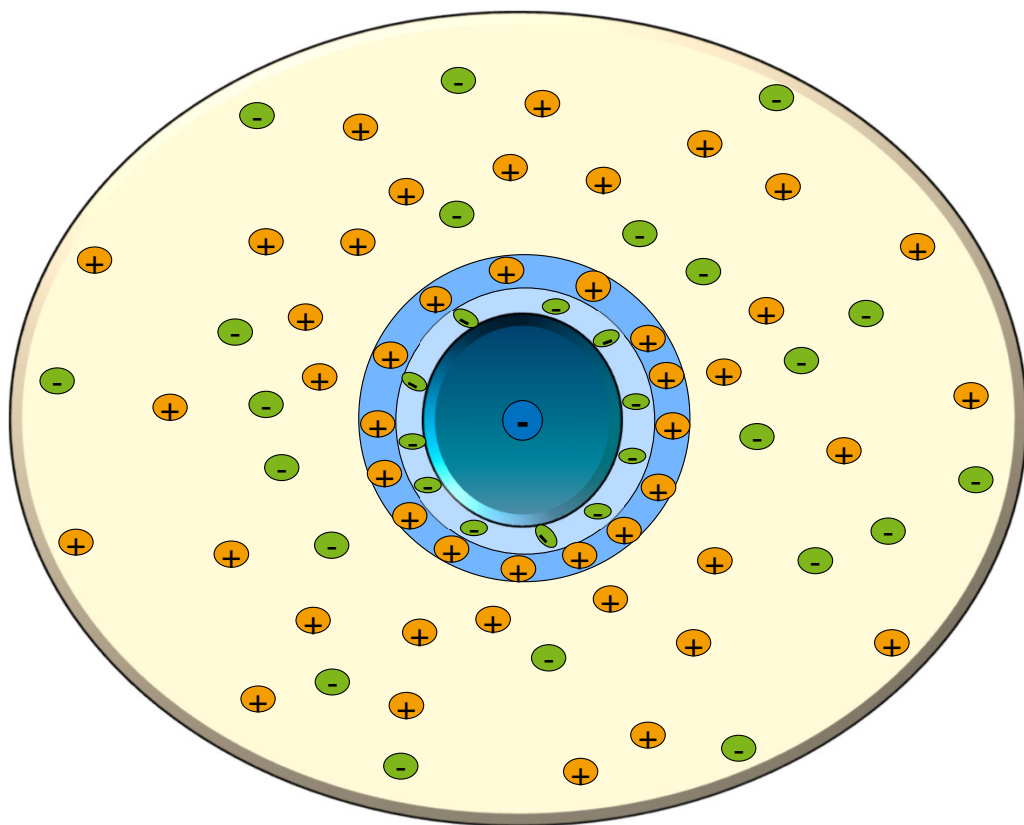
What is zeta potential?

How do wetting & dispersing additives influence zeta potential?

When to add it to your toolbox?

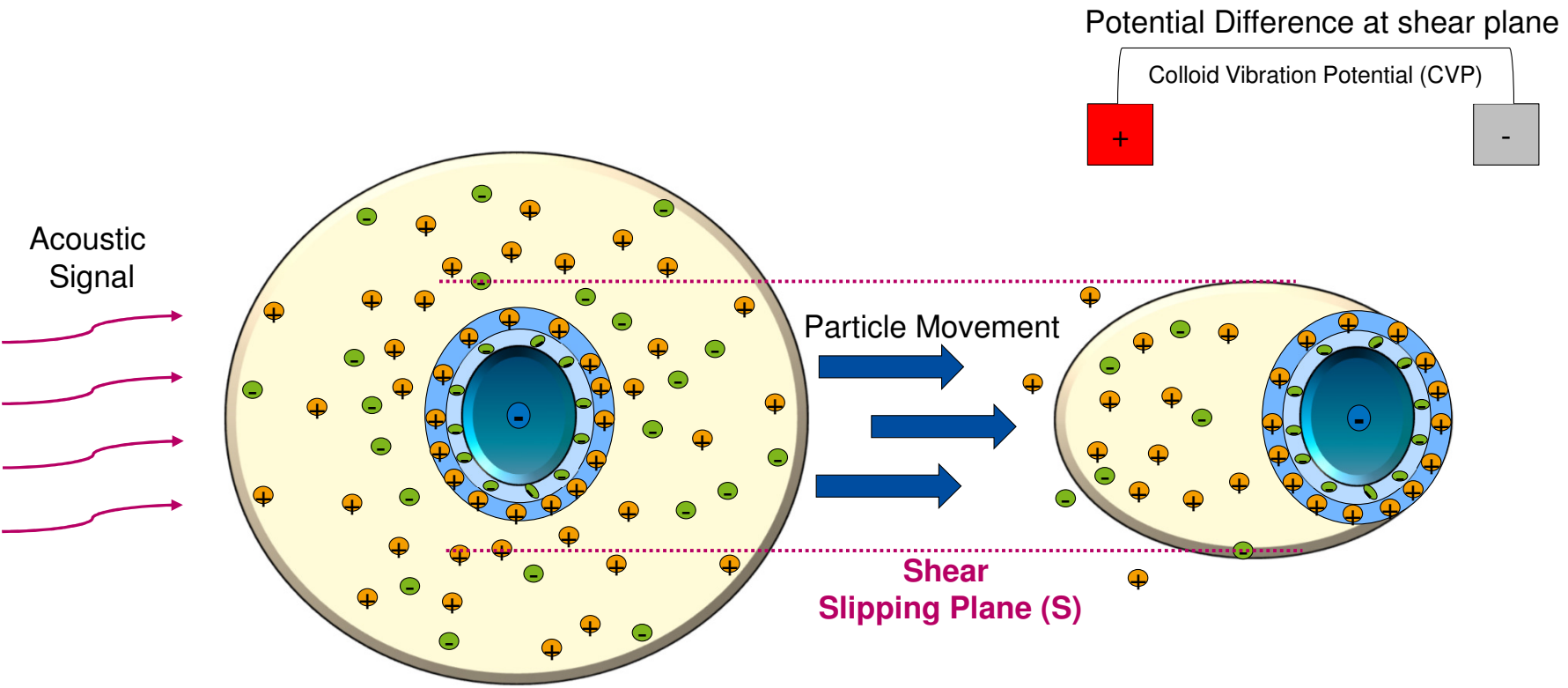
Zeta Potential

Ion layers with particle (negative surface potential)

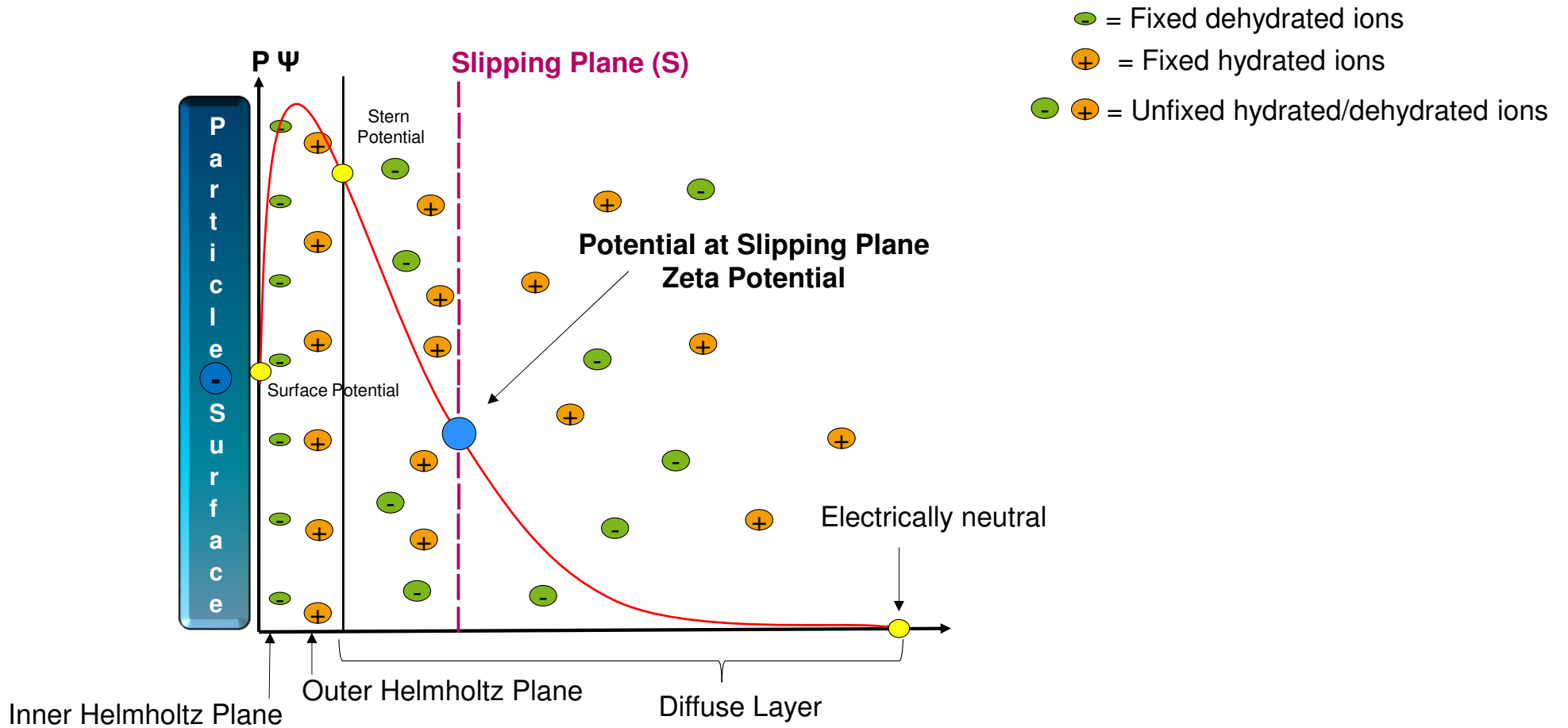


- = Fixed dehydrated ions
 - = Inner Helmholtz Plane
 - = Fixed hydrated ions
 - = Outer Helmholtz Plane
 - = Diffuse Layer
 - + ● = Unfixed hydrated/dehydrated ions
- } Stern Layer

Zeta Potential Creation

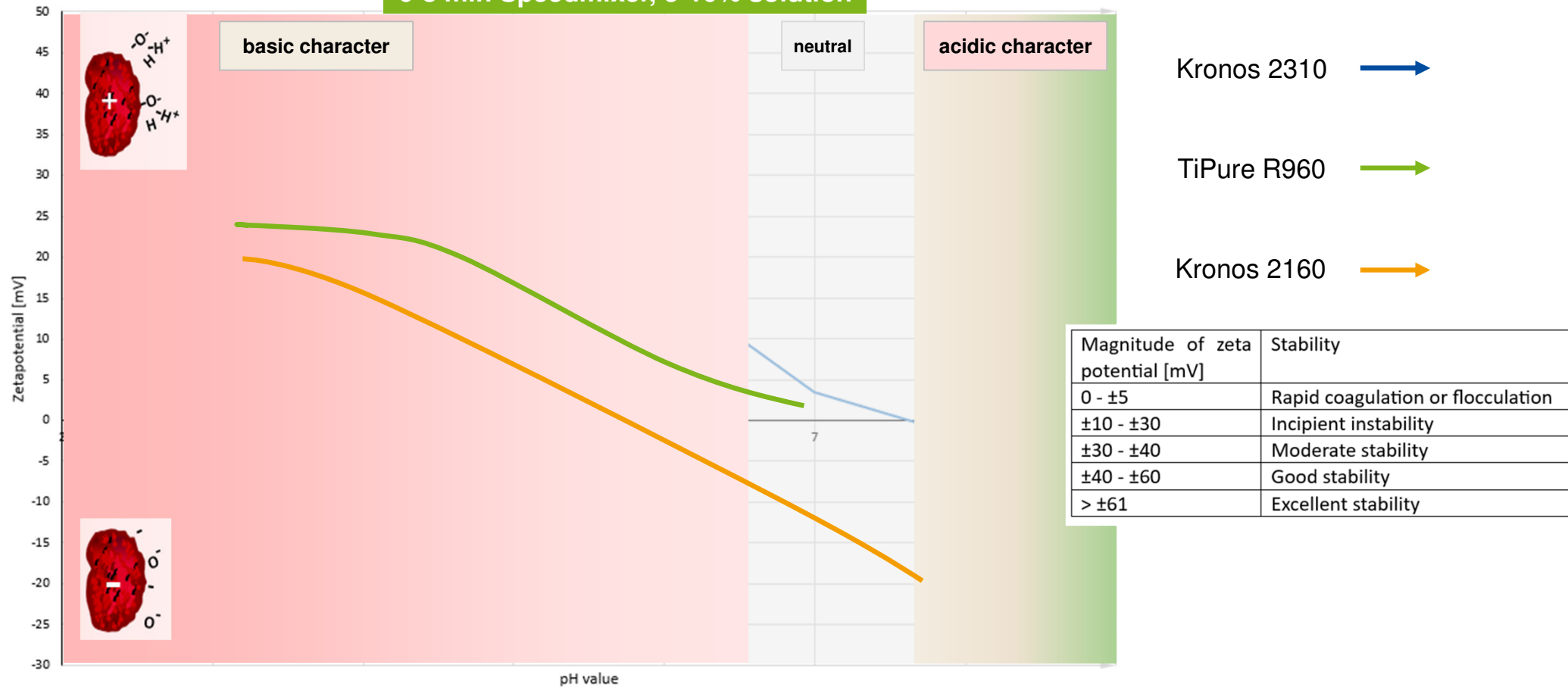


Zeta Potential Side View



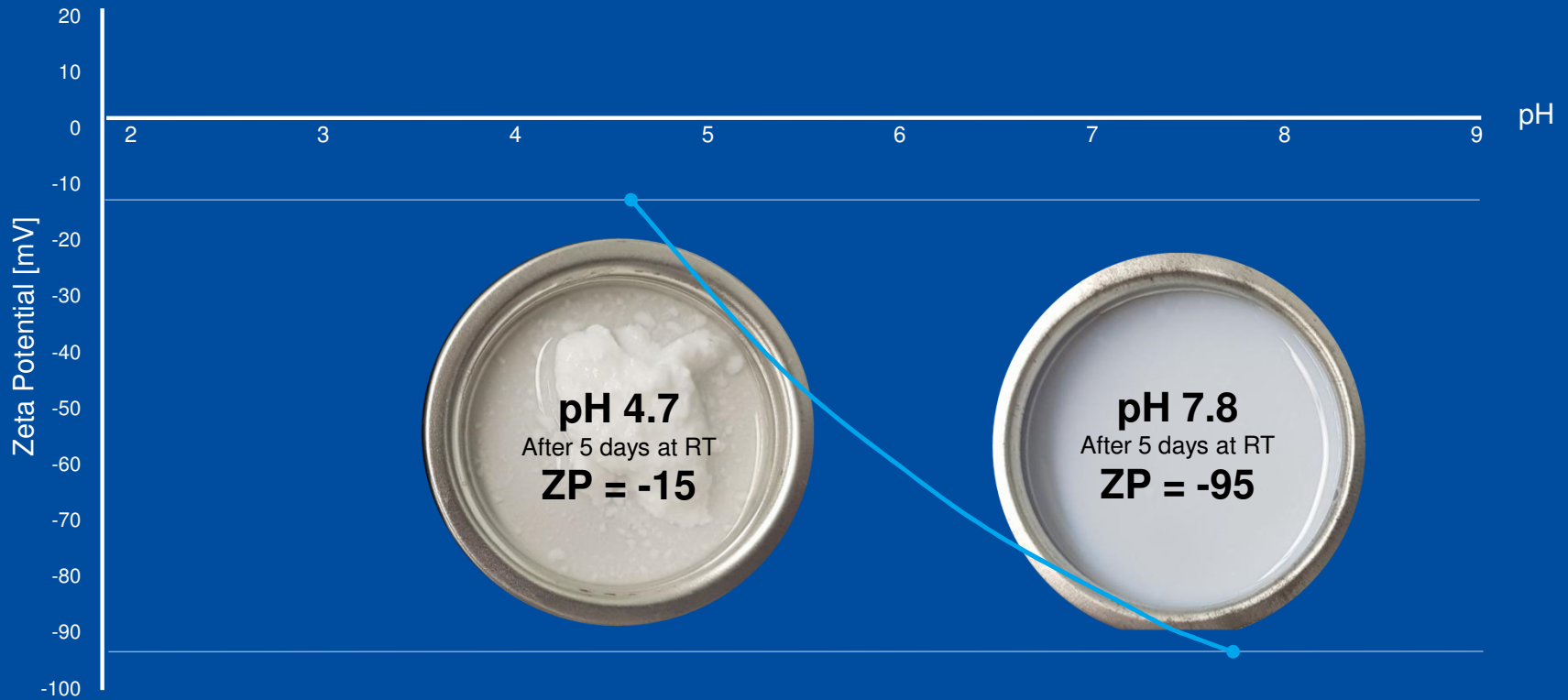
pH Value and Surface Charge of Various Pigments in Water

6-8 min Speedmixer, 5-10% solution

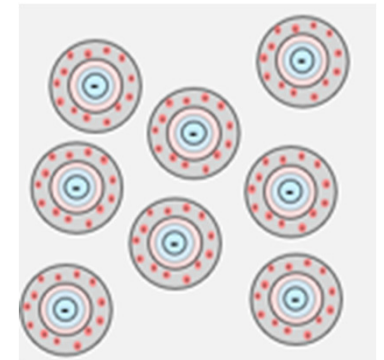
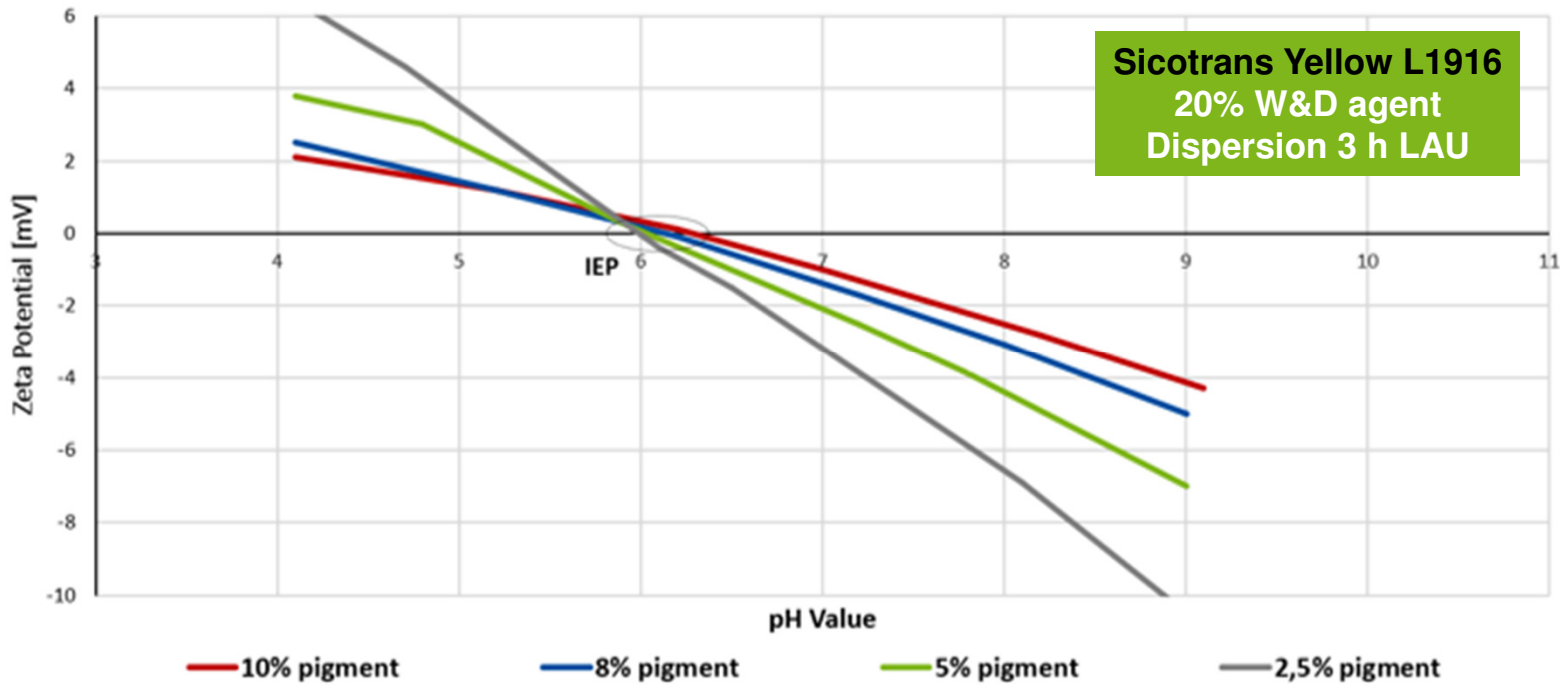


Clear Basecoat

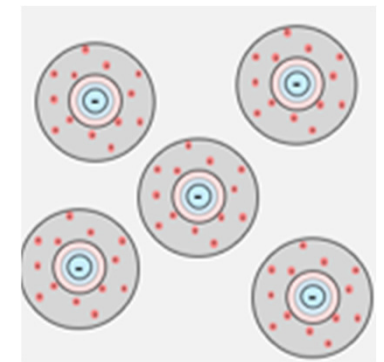
based on acrylic dispersion binder reduced to approximately 10% solids



Zeta Potential Curve as a Function of Electrolyte Concentration



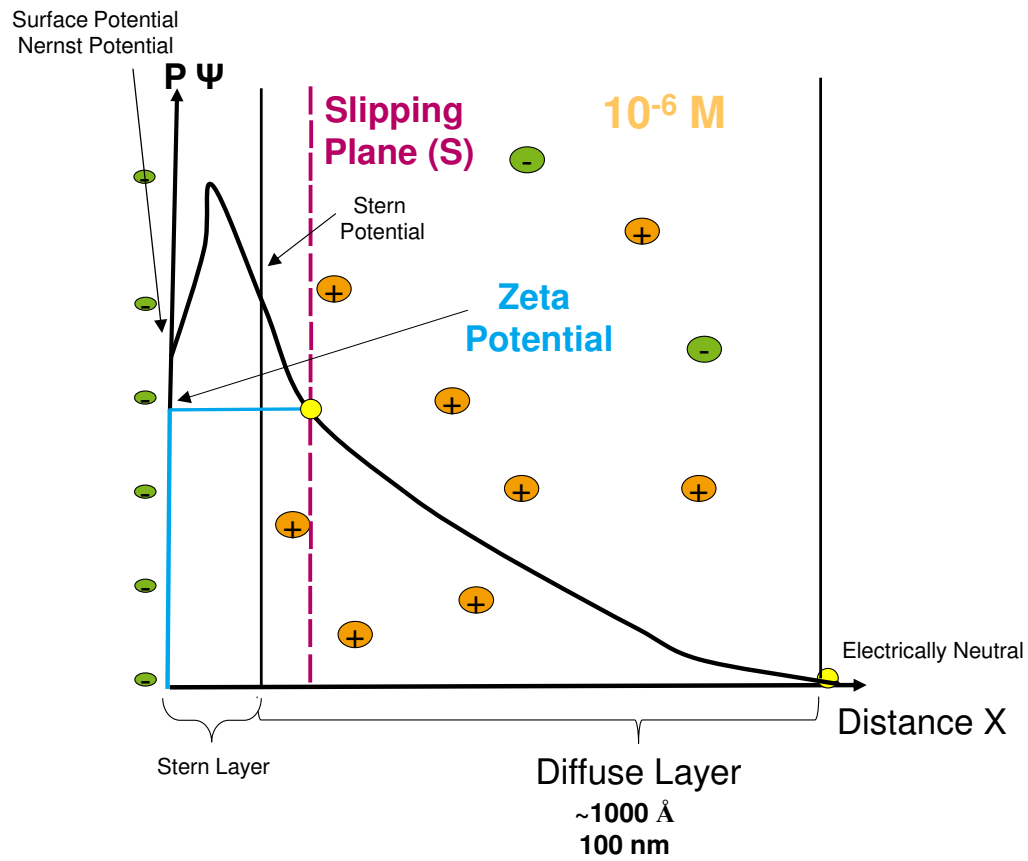
Smaller Diffuse Layer



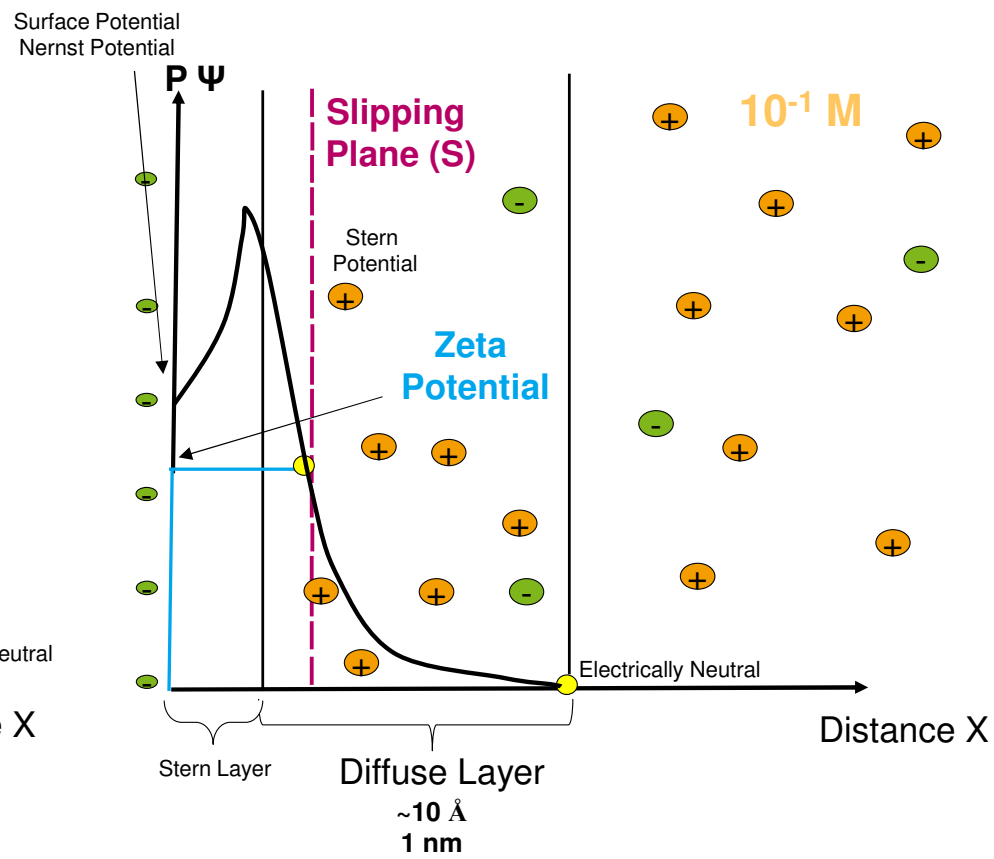
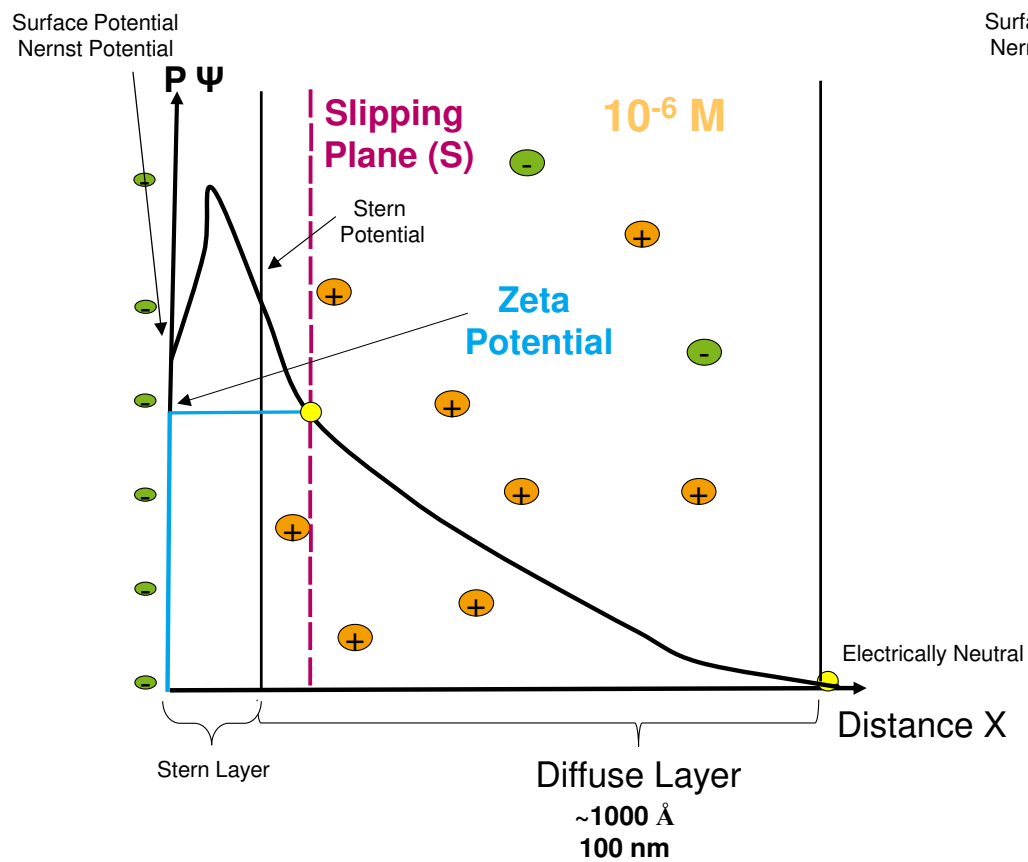
Larger Diffuse Layer

- IEP remains more or less constant
- decreasing the number of particles, Zeta Potential increases
 - correlates with number of particles, not with particle size

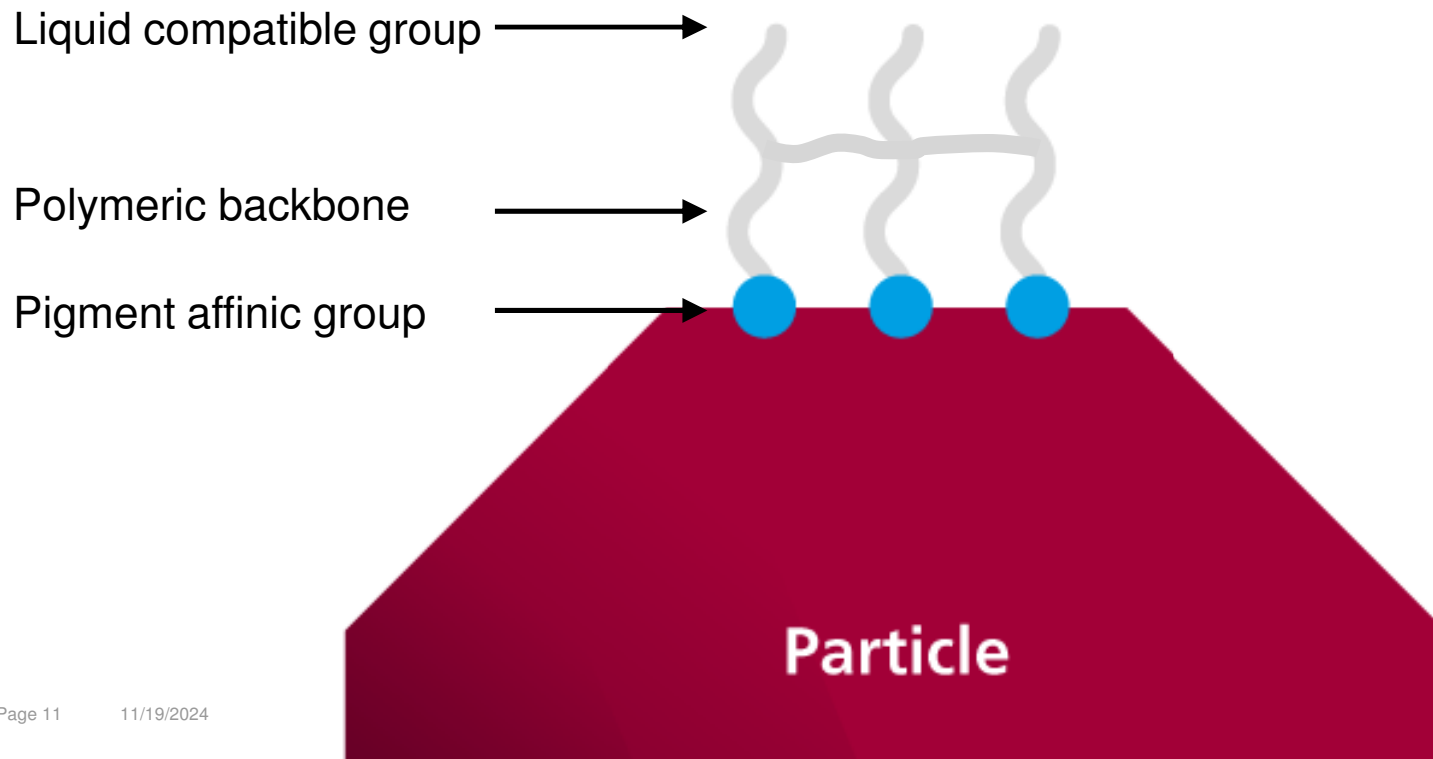
Zeta Potential



Zeta Potential



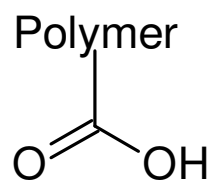
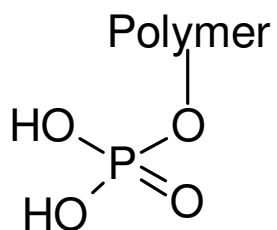
Zeta Potential and Wetting & Dispersing Additives



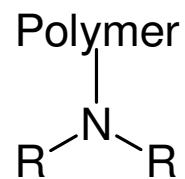
Zeta Potential and Wetting & Dispersing Additives

Pigment affinic group

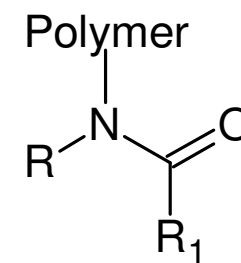
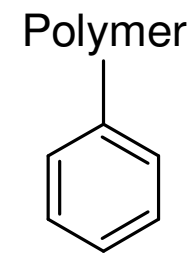
Acidic



Aminic



Non-ionic



Zeta Potential and Wetting & Dispersing Additives

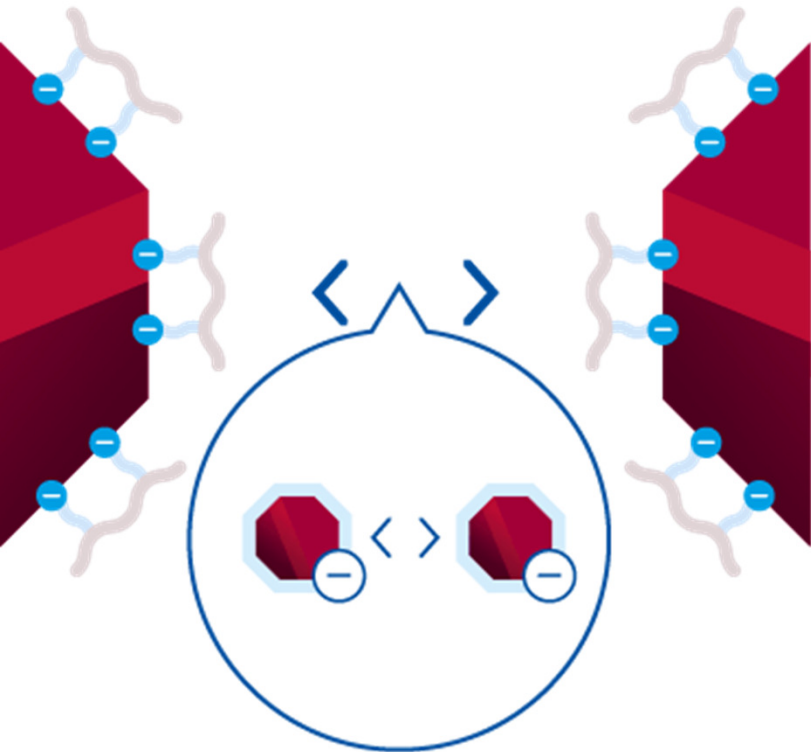
Electrostatic stabilization
(electrostatic repulsion)

Steric stabilization
(steric hindrance)

Electrosteric stabilization

Zeta Potential and Wetting & Dispersing Additives

Electrostatic stabilization
(electrostatic repulsion)



Steric stabilization
(steric hindrance)

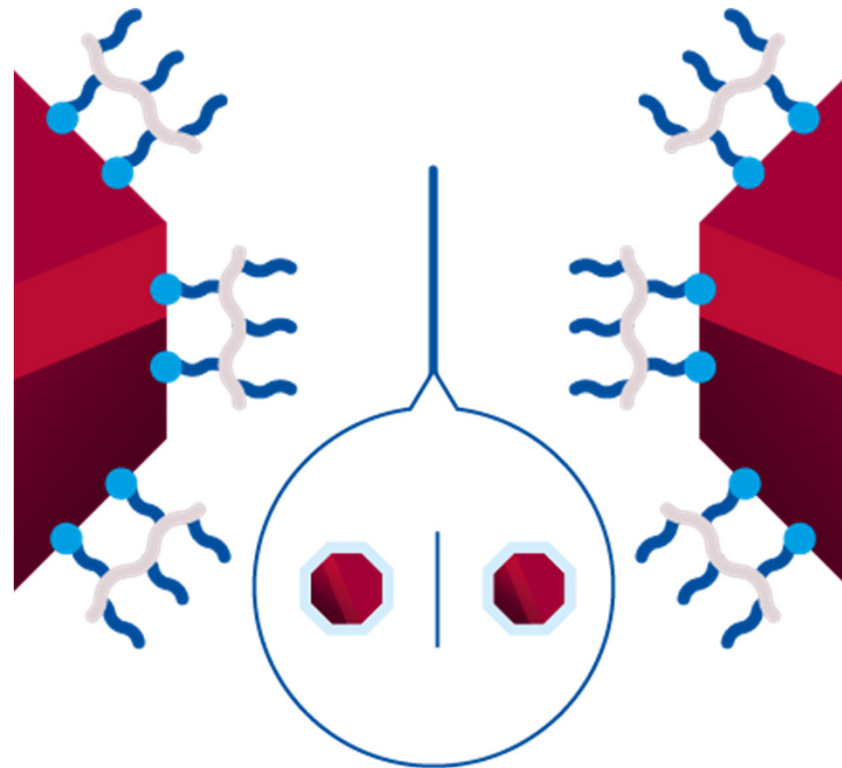
Electrosteric stabilization

Zeta Potential and Wetting & Dispersing Additives

Electrostatic stabilization
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Steric stabilization
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Electrosteric stabilization

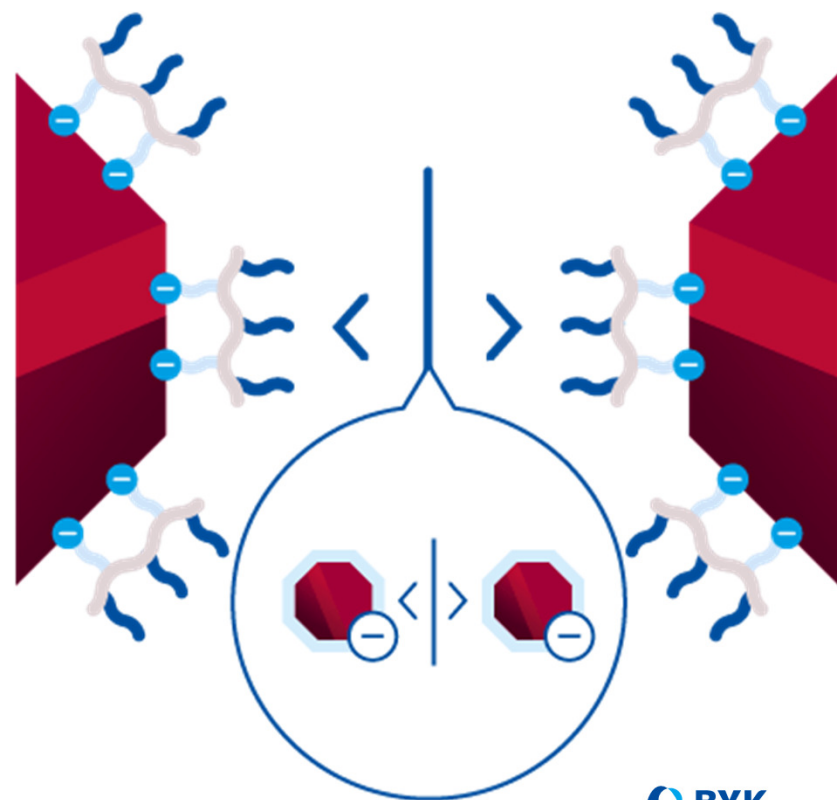


Zeta Potential and Wetting & Dispersing Additives

Electrostatic stabilization
(electrostatic repulsion)

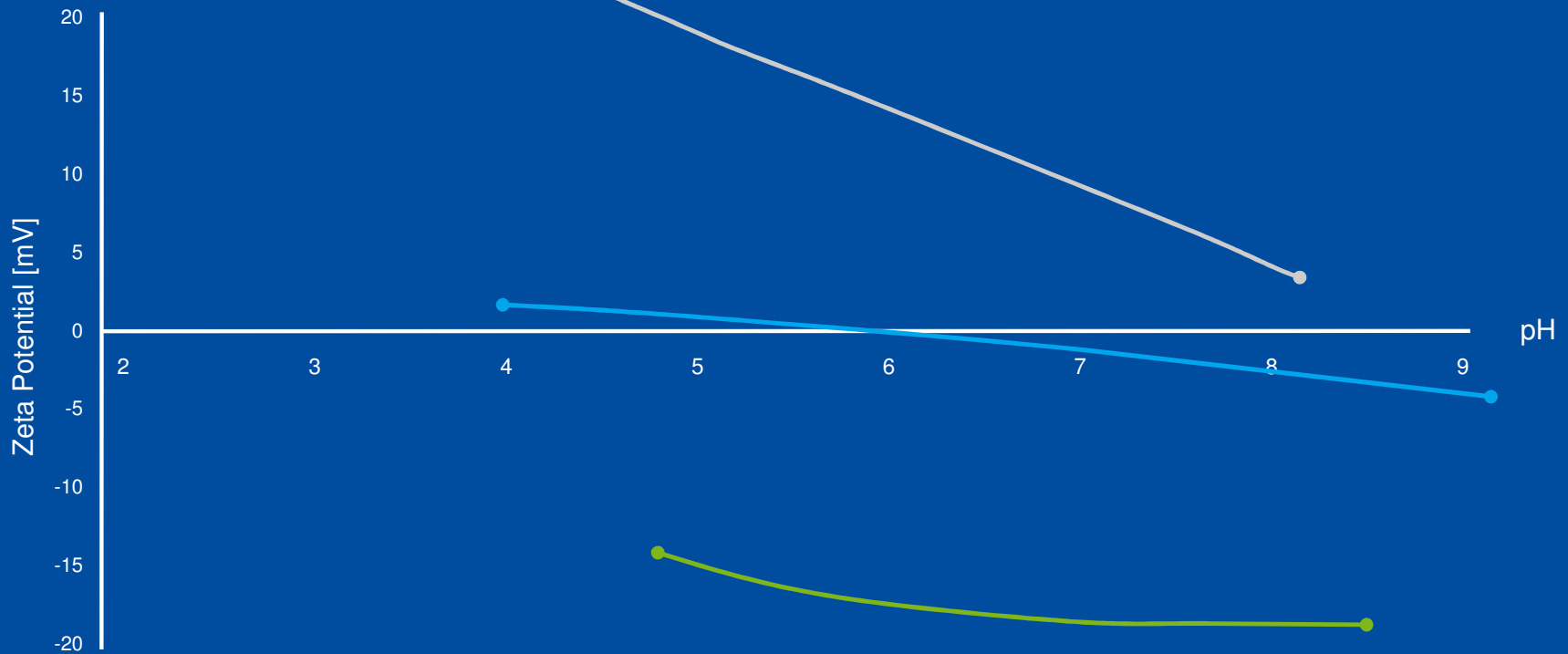
Steric stabilization
(steric hindrance)

Electrosteric stabilization



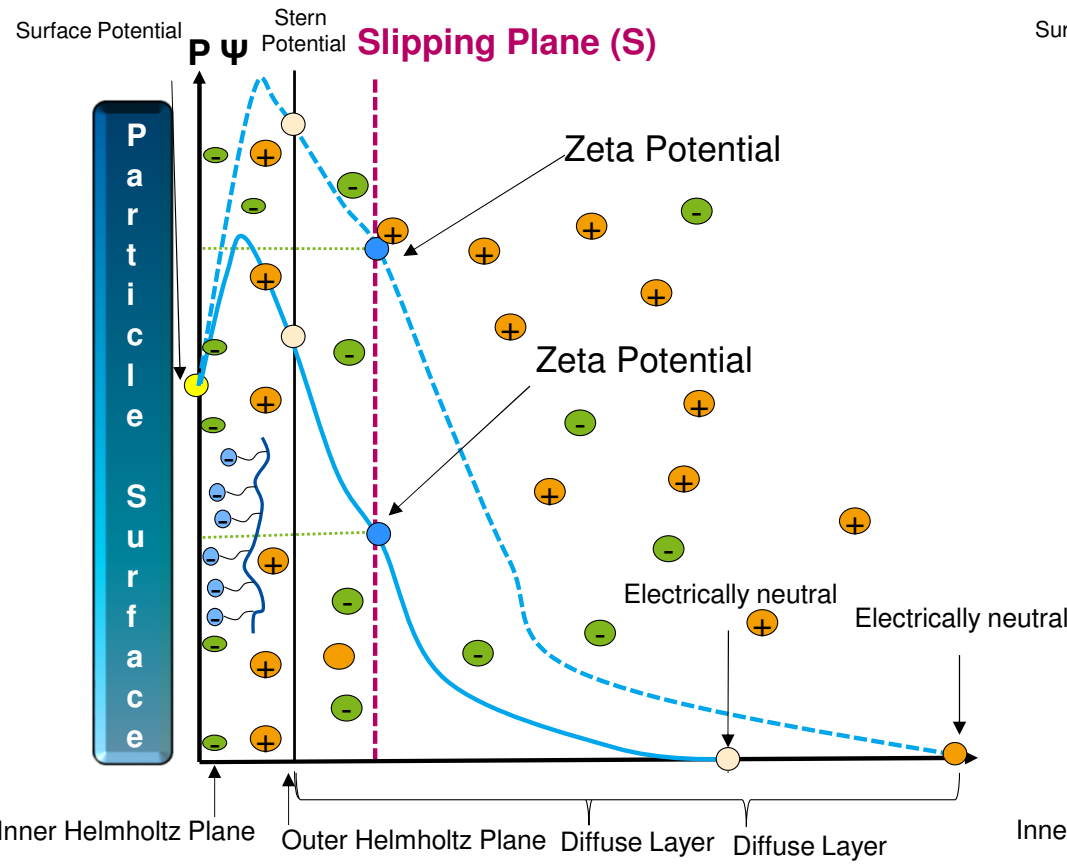
Adding Zeta Potential to your Toolbox

- Control
- Additive 1: Steric Stabilizing
- Additive 2: Electrostatic Stabilizing

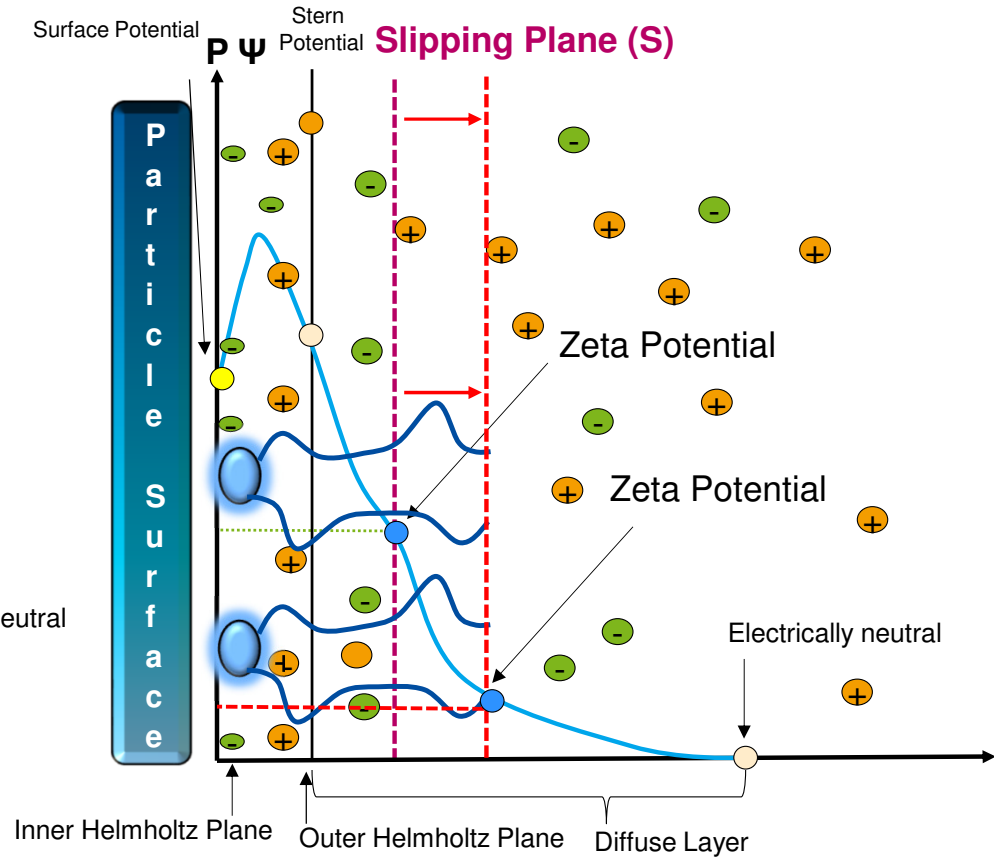


Transparent Iron Oxide 10% pigment in solution

Wetting and Dispersing Additives Influence Zeta Potential



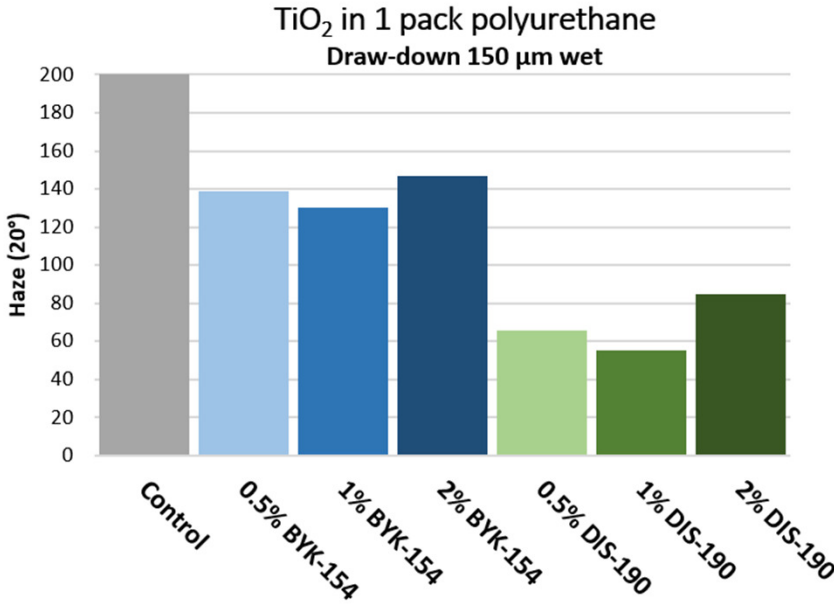
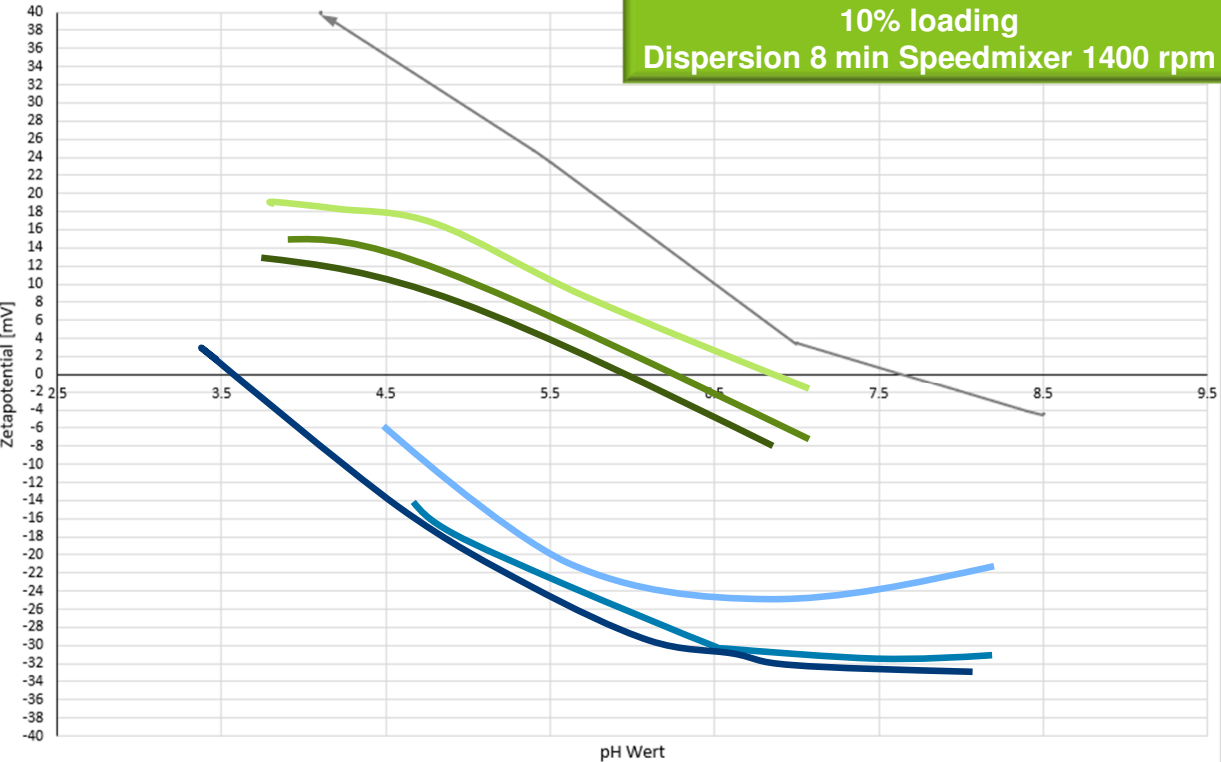
Electrostatic Stabilization



Steric Stabilization

Molecular Design of W&D Additive on Zeta Potential

Kronos 2310
10% loading
Dispersion 8 min Speedmixer 1400 rpm



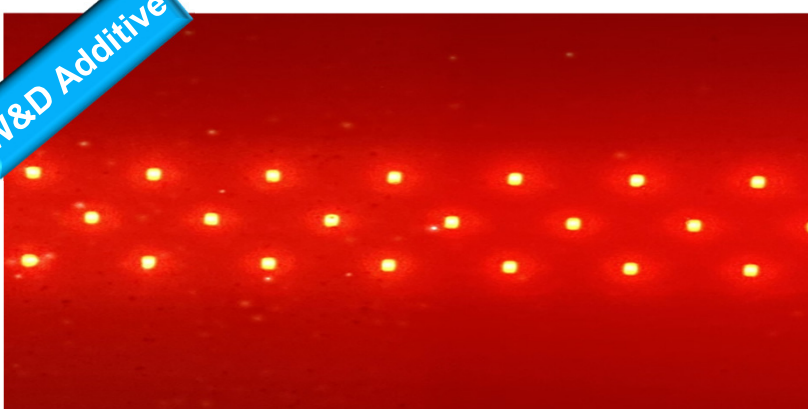
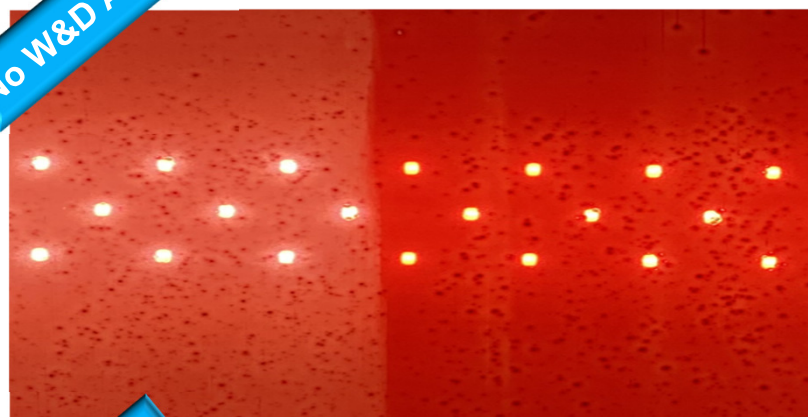
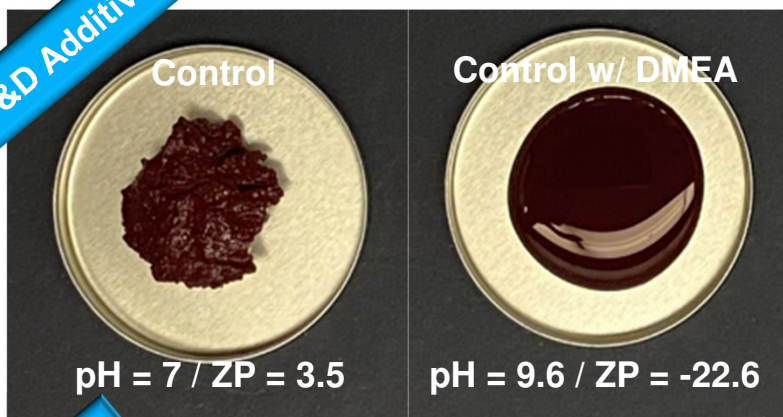
Molecular Design of W&D Additive on Zeta Potential

Organic PR174 Pigment

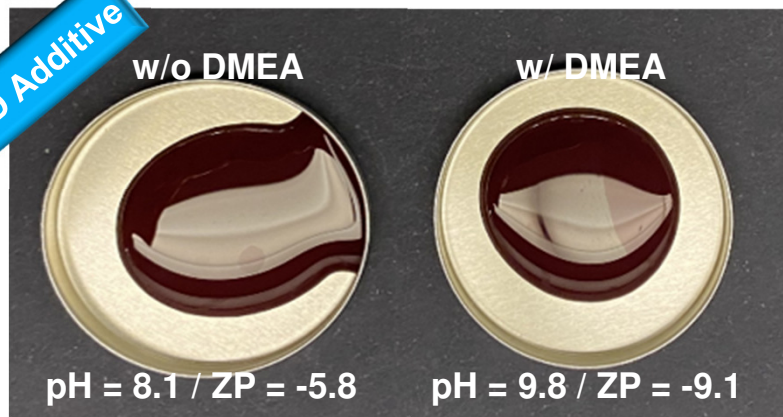
No W&D Additive

No W&D Additive

W&D Additive



W&D Additive



W&D Additive
Sterically
Stabilizing
↑ Mw

Conclusion: Zeta Potential for Design of W&D Additives

OPPORTUNITIES

- Helpful technique to detect W&D additive mode of action (electrostatic vs. electro-steric) stabilization
- Can evaluate physical stability of electrostatically stabilized systems
- Knowledge about particle surfaces:
 - I. Determine optimal coverage at the surface
 - II. Adsorption behavior of differing compounds
 - III. Optimization and design of W&D additive
- Analytical tool for process control with high reproducibility

LIMITATIONS

- Unable to establish correlation between zeta potential and state of dispersion
- Sterically stabilizing W&D additives result in low zeta potential → challenging to differentiate
- No information on let-down compatibility and paint properties. Zeta potential value of a sample on its own does not tell the whole story
- Zeta potential should be combined with other analytical tools, such as particle size measurement and physical testing to get better understanding

Thank you for
your attention.

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Zeta Potential Instrumentation

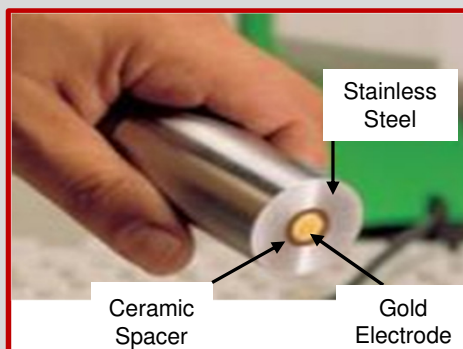
Device - Method

Device Quantachrome DT310 / 1201

Measuring probe: Sender and receiver

pH adjustment:

Titration with potassium hydroxide (1N KOH)
and hydrochloric acid (1N HCl)



Electroacoustic measurement method CVI (Colloidal Vibration Current)

Ultrasound \rightarrow Particle movement \rightarrow CVI

