Combining the need for APE-free additives with improved performance

Pat-Add DA 202

A new generation wetting agent for water borne Architectural paints

PATCHAM
www.patchamltd.com

Patcham Virtual Seminar
May 28, 2020
Presenter - John Du

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Challenges, global trends, developments

Environmental pressure: sustainability, green movement, climate change.

WB coatings, lowering VOC
Renewable RM (raw materials)
Ban on heavy metal RM, no aromatics, no halogens

Regulations like EPA, REACH, etc.

Economic pressure: “global economy”. High Market Dynamics. Performance, durability, easy-to-apply

Poly-functional coating surfaces: easy-to-clean, self-cleaning, anti-fogging, information (temperature, time), self-healing, anti-icing

Challenges, global trends, developments

Ban on Alkyl Phenol Ethoxylates

Consequence of climate change (high temperature +/- humidity)

Increasing acceptance of Tintometric coloring systems

Environmental Pressure

SUSTAINABILITY, GREEN MOVEMENT, CLIMATE CHANGE

- Waterborne coatings, lowering VOC
- Renewable raw materials
- Ban on heavy metal RM, no aromatics, no halogens
- Oil-free defoamers
- Ban on Alkyl Phenol Ethoxylates

Trends and Challenges: WB vs SB

Surface tension

Water: 72 mN/m

Organic solvents: lower than water, wide variety

Evaporation speed

Water: slow to fast, depending on relative humidity

Organic solvents: fast to slow, depending on selection

Purity

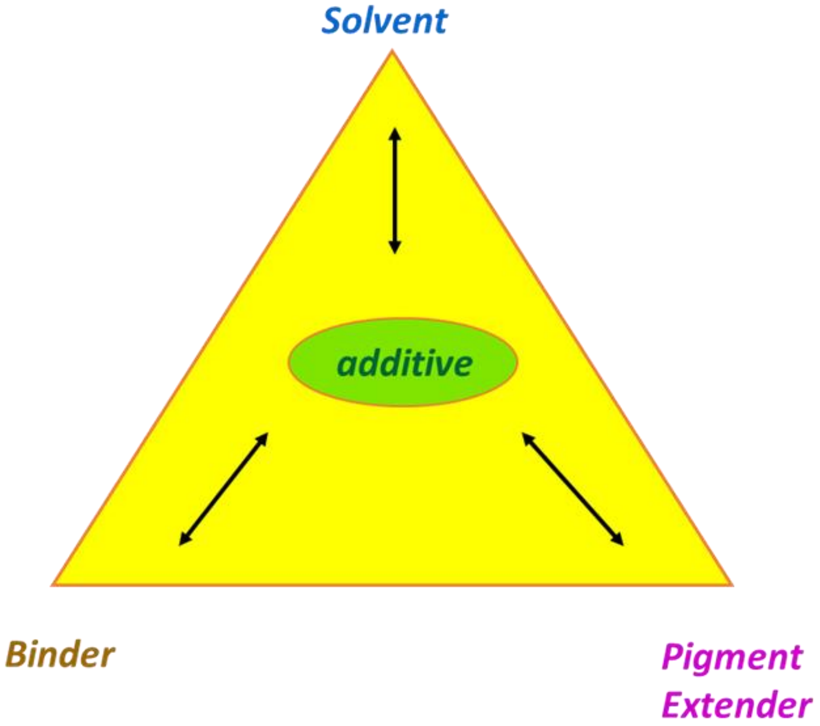
Water: local; purified, demineralized water

Organic solvents: industrial quality

Additive Selection

Coating Additives are auxiliary components used to realize desired properties during production, storage, application or exposure*

1. *Pigments 0-80% av. 25%*
2. *Binders 3-70% av. 30%*
3. *Solvents 0-80% av. 50%*
4. *Additives 0.1-5% av. 2-4 %*



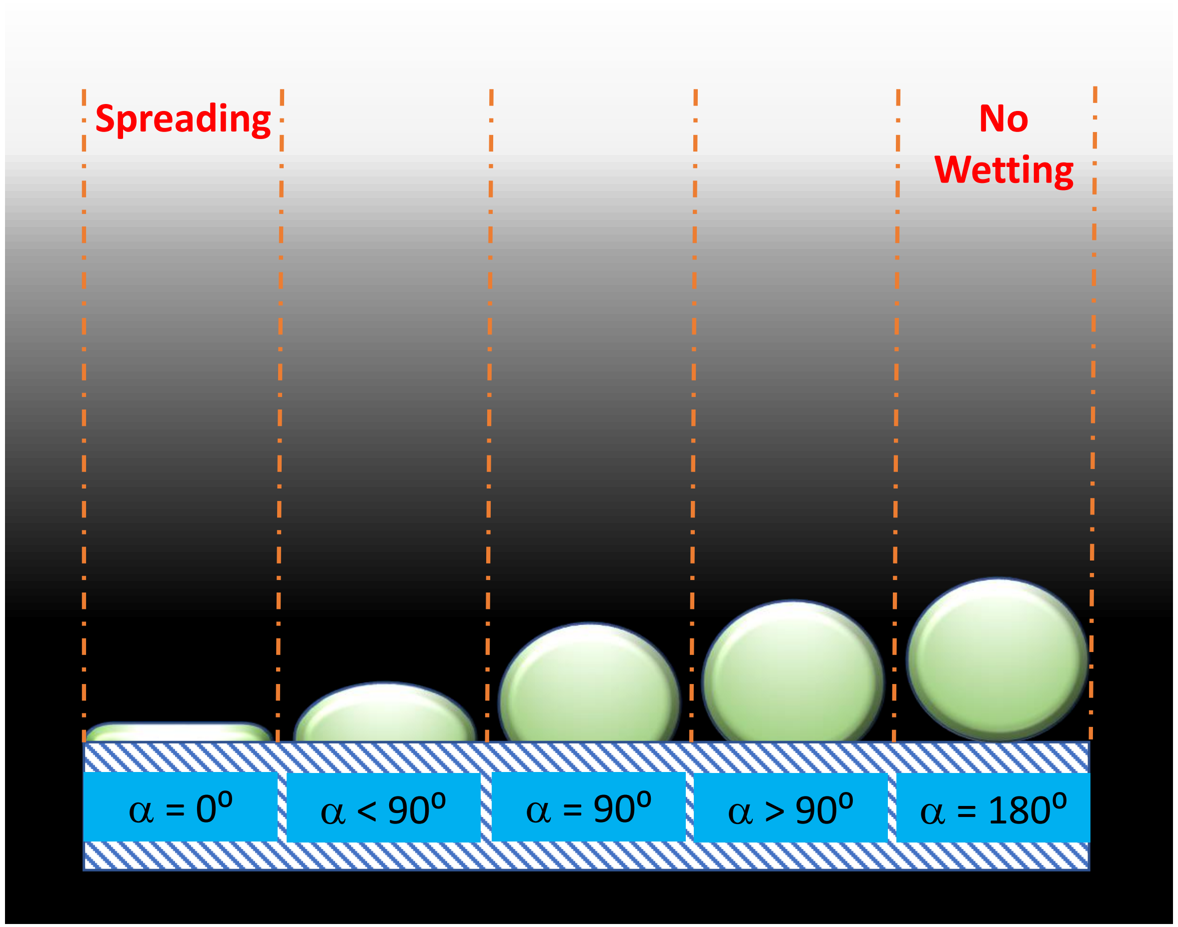
* Additives for Coatings, J H Bieleman Wiley-VCH 2000

Contents


No Wetting


Rapid Wetting
with Additive

Contact Angle and Wetting Properties



Relationship between the contact angle and wetting characteristics

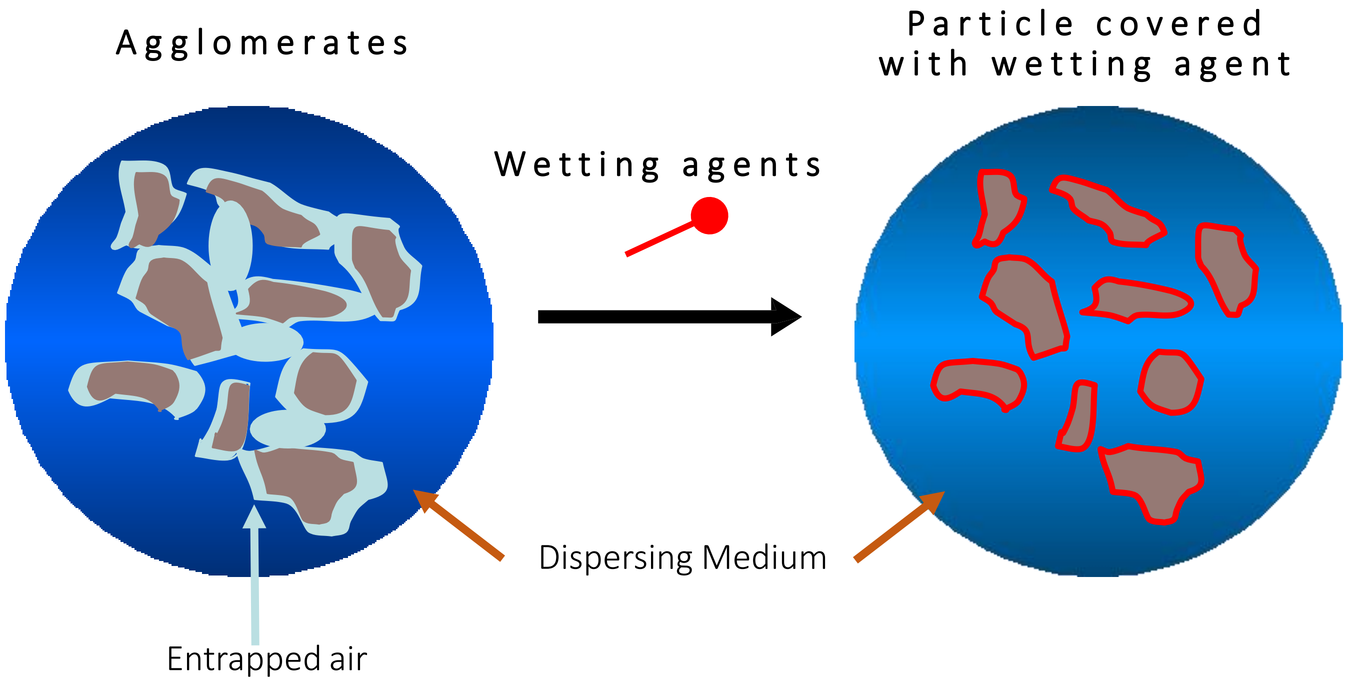
In general the following apply:

- A substrate with high surface energy is easily wet out
- A liquid with a low surface energy is good at wetting
- Wetting is ideal if the surface energy of the liquid is significantly less than the surface energy of the substrate

Pigment Dispersion and Stabilization

WETTING (first of three stages)

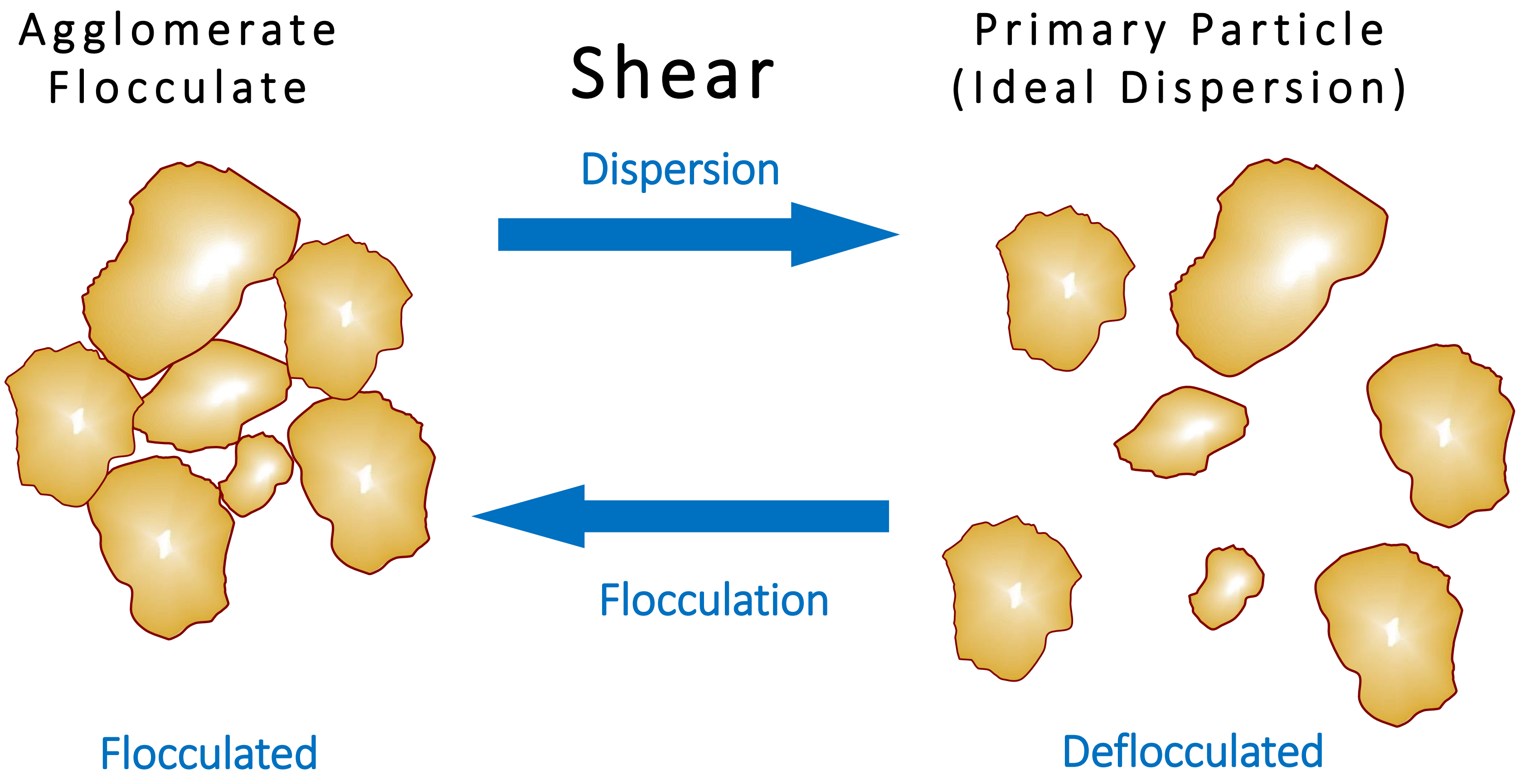
Pigment wetting is the displacement of air and moisture at the pigment surface by the liquid of the millbase



Good wetting (adjusting Surface Tension liquid phase, through wetting agent):

- enabling high pigment solids
- low mill-base viscosity
- high milling efficiency

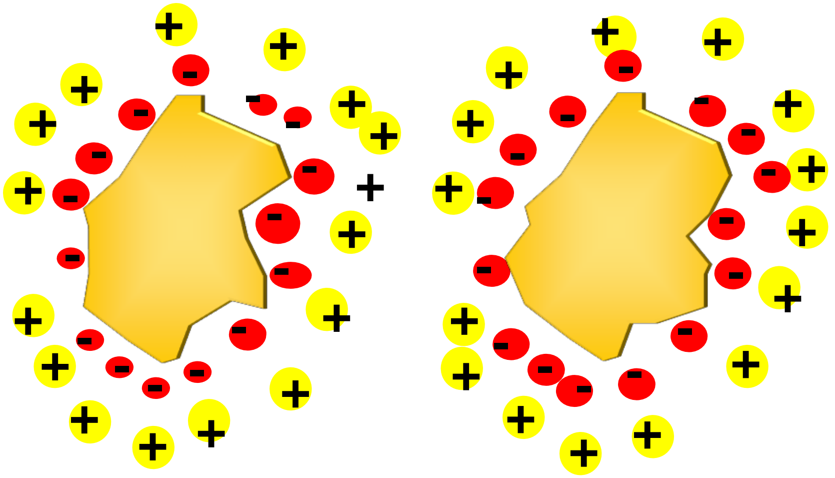
Pigment Dispersion



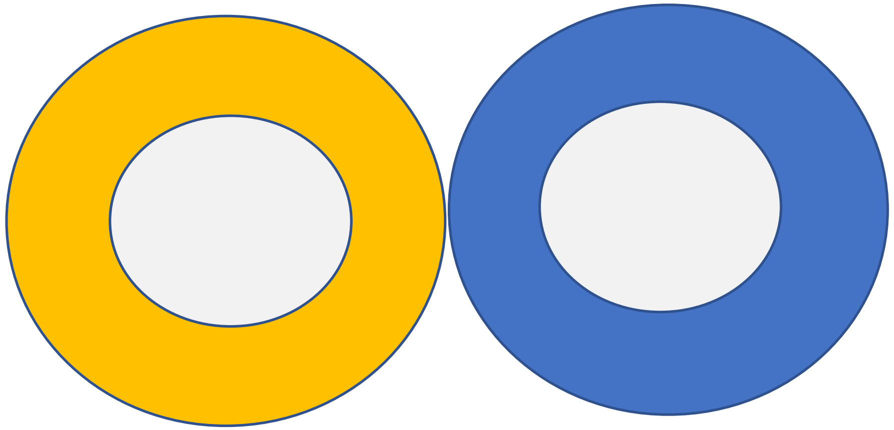
Pigment Dispersion and Stabilization

STABILIZATION

Electrostatic Repulsion



Steric/ Entropic



Main stabilization in polar/ aqueous systems

Main stabilization in a-polar systems, including water-less drying stage

Dispersant Requirements:

- Contains affinic groups providing strong adsorption on pigment surface
- Resin/solvent compatible chains directed into the surrounding vehicle

Technology Challenge

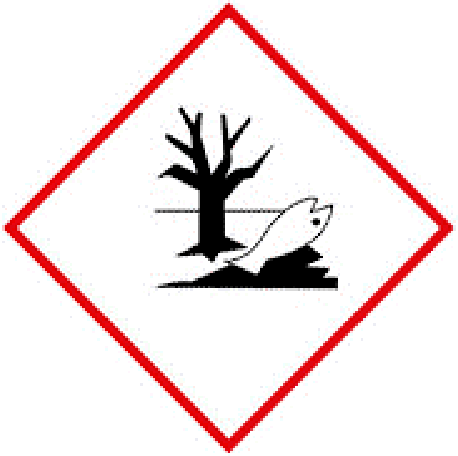
FOR WATERBORNE DISPERSIONS

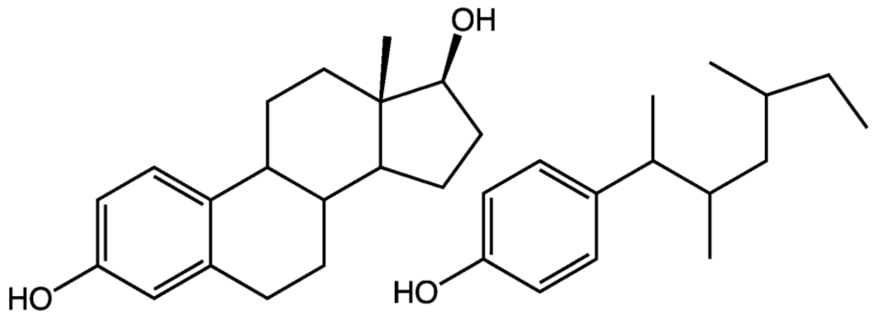
- Optimization dispersion stability and paint performance
- Maintaining stabilization of pigments during transition from polar to non-polar environment during film formation
- Shift from electrostatic to steric stabilzation

Contents

APE – Alkylphenol Ethoxylates

- Group of nonionic wetting agents – main product is NPE (nonyl phenol ethoxylate)
- Biodegradability – 60% minimum degradation within 28 days
- Effect to aquatic life - Bioaccumulation
- Classified as endocrine disruptors
- Banned and restricted to be used in the industry





Structure of the hormone estradiol and one of the nonylphenols.

Move to APE-free Emulsion Paints

EPA Directive

U.S. EPA Office of Pollution and Toxics

"EPA Adds Nonylphenol Ethoxylates to Toxics Release Inventory"

– promoting greater transparency for chemicals used in cleaners, detergents, paints, etc.

- Effective for the 2019 TRI (Toxics Release Inventory)

Canada

Proposed regulations to reduce the use of APE's by 95% (2010)

EU

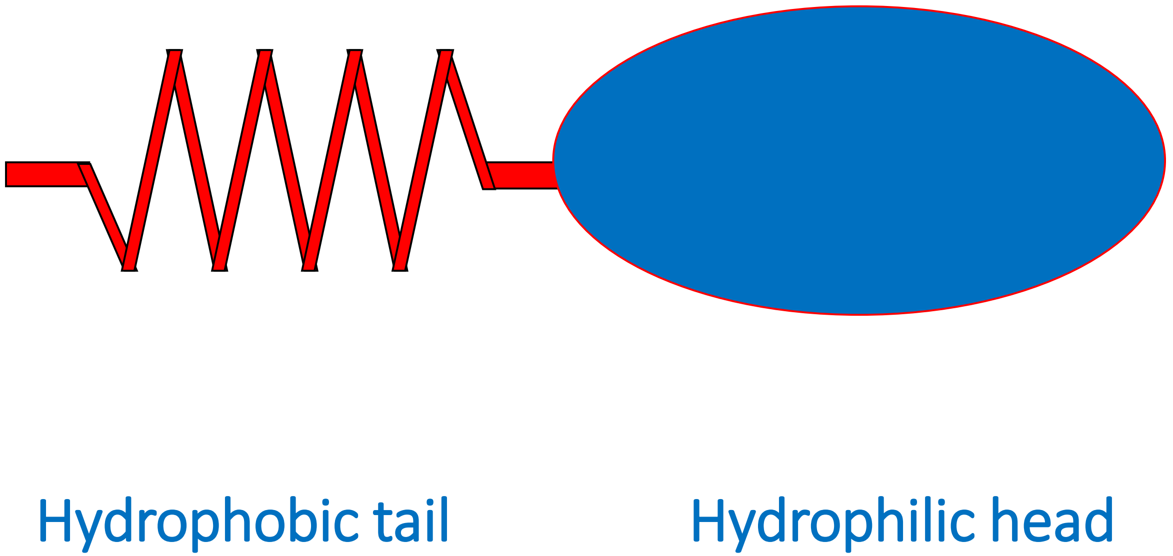
APE's cannot be used at 0.1% or greater (2003)

Contents

Nonionic wetting agents

1ST GENERATION

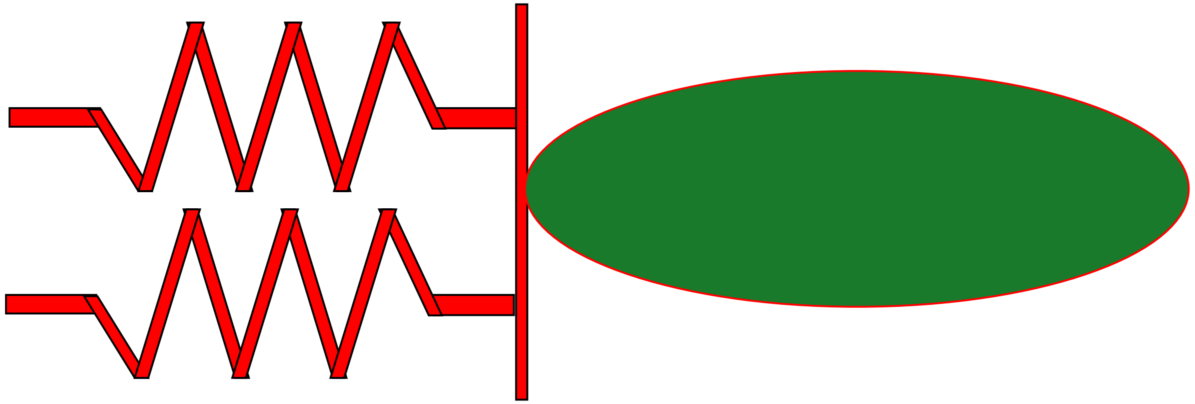
Classical non-ionic: APE



Nonionic wetting agents

2ND GENERATION

Gemini-type
Split hydrophobe



Hydrophobic tail

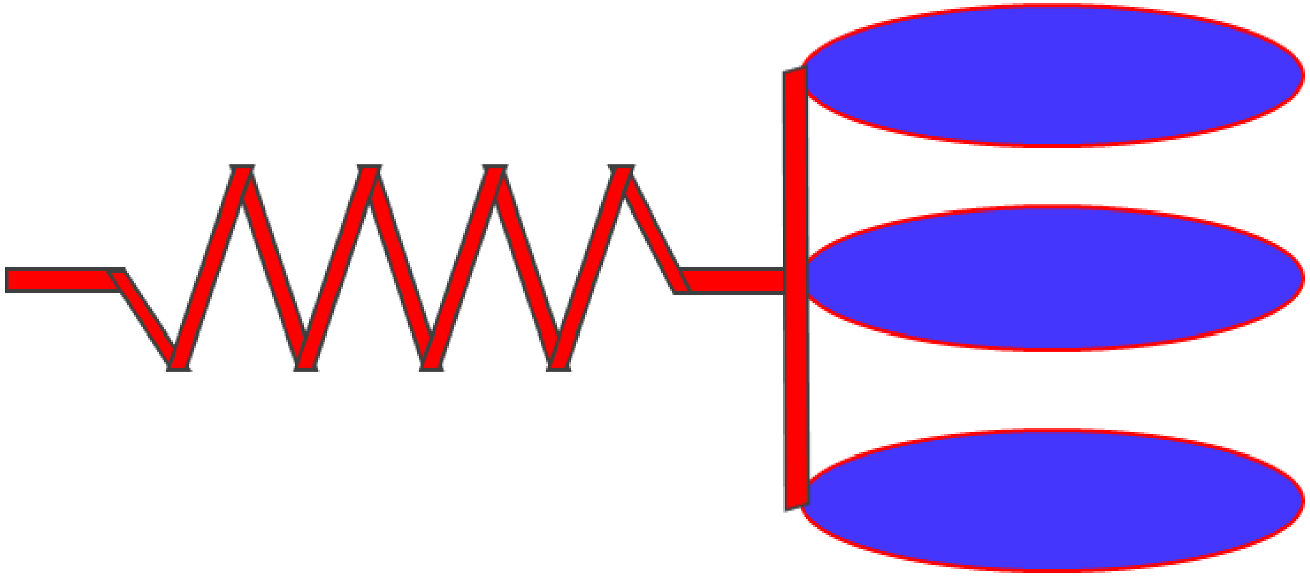
Hydrophilic head

Still missing strong anchoring functionality onto pigments, weak steric stabilizer due to **COILING** of long linear PEG-group

3RD GENERATION

Pat-Add DA 202

Patcham's 3 Master; Triple Masted Schooner Technology



Hydrophobic tail

TAIL: Multi-functional anchoring moieties to firmly anchor unto multiple substrate compositions

Hydrophilic head

HEAD: *Three-master* structure optimal packaging and stabilizing density

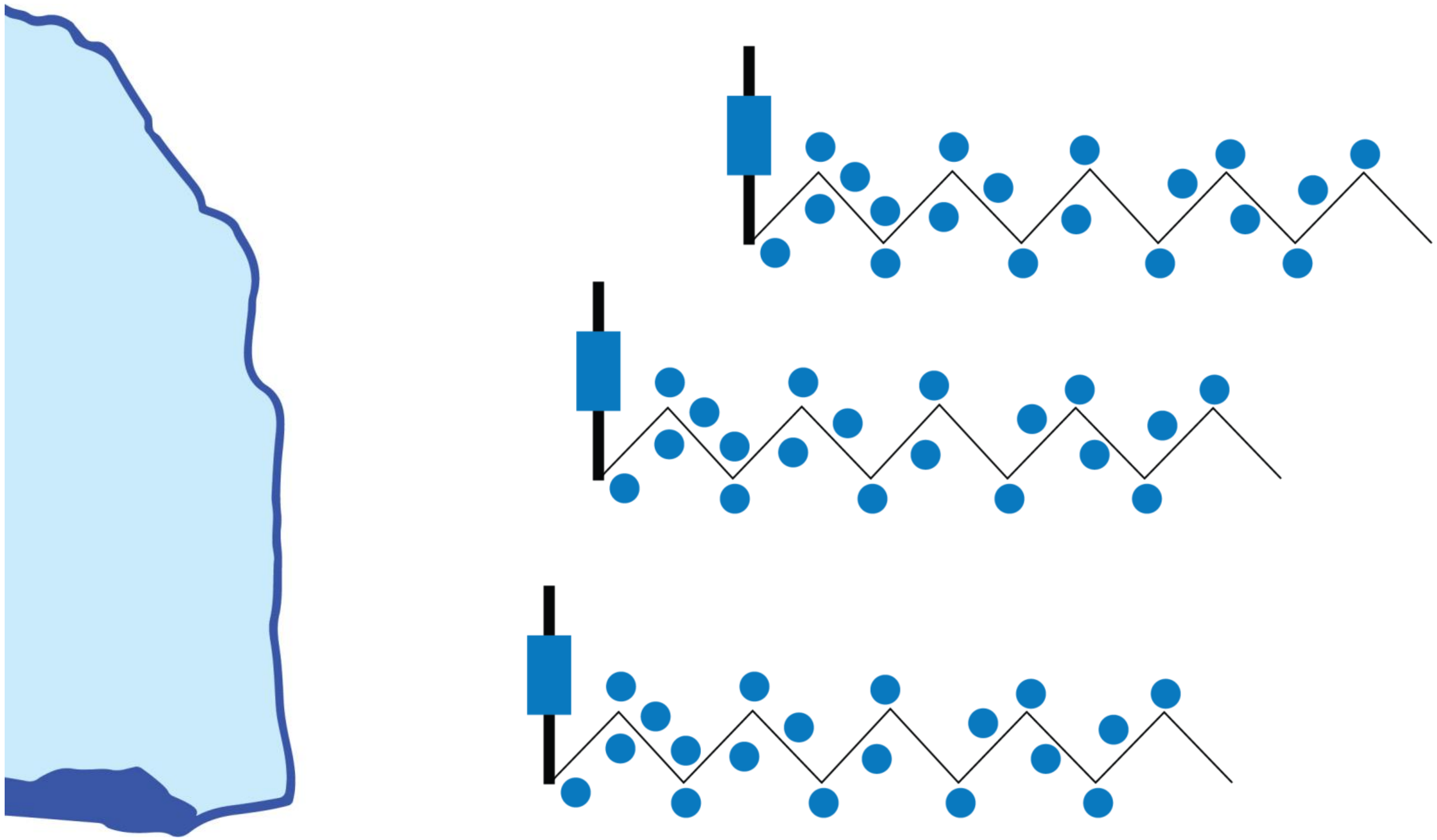
Nonionic wetting agents

Technology : 3-Master concept!
3-hydrophilic groups per hydrophobic chain

- Nonionic wetting agent in WB (Base-) paints and colorants
- Superior stabilization via multiple variety of pigment affinic groups
- Dense packing of hydrophilic group offers increased stability
- Proximity and multiple hydration sites resists Flocculation
- Resistant to alkyl chain coiling during dehydration
- APE-free!

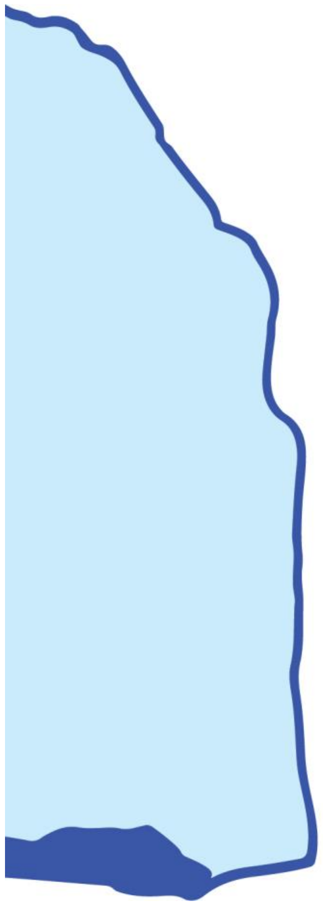
Wetting Agent - during film formation

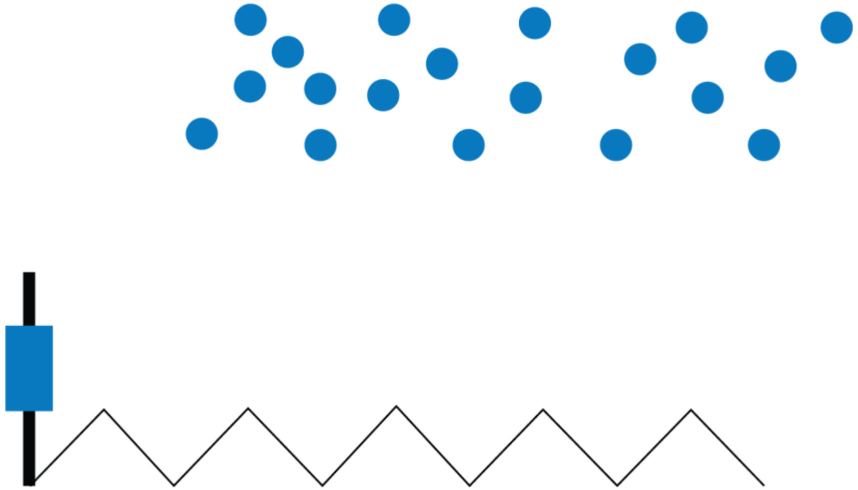
APE based Wetting Agents



Wetting Agent – during Film Formation

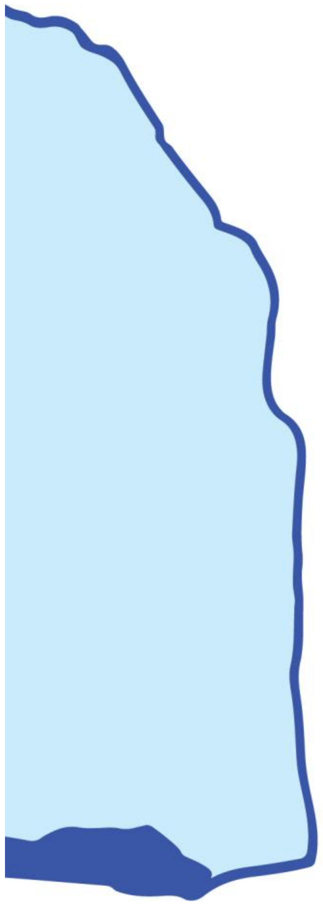
APE based Wetting Agents

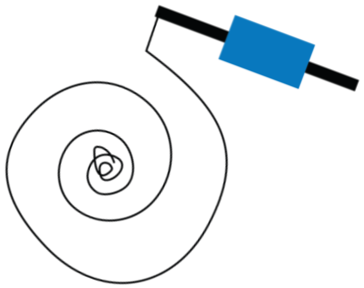




Wetting Agent – during Film Formation

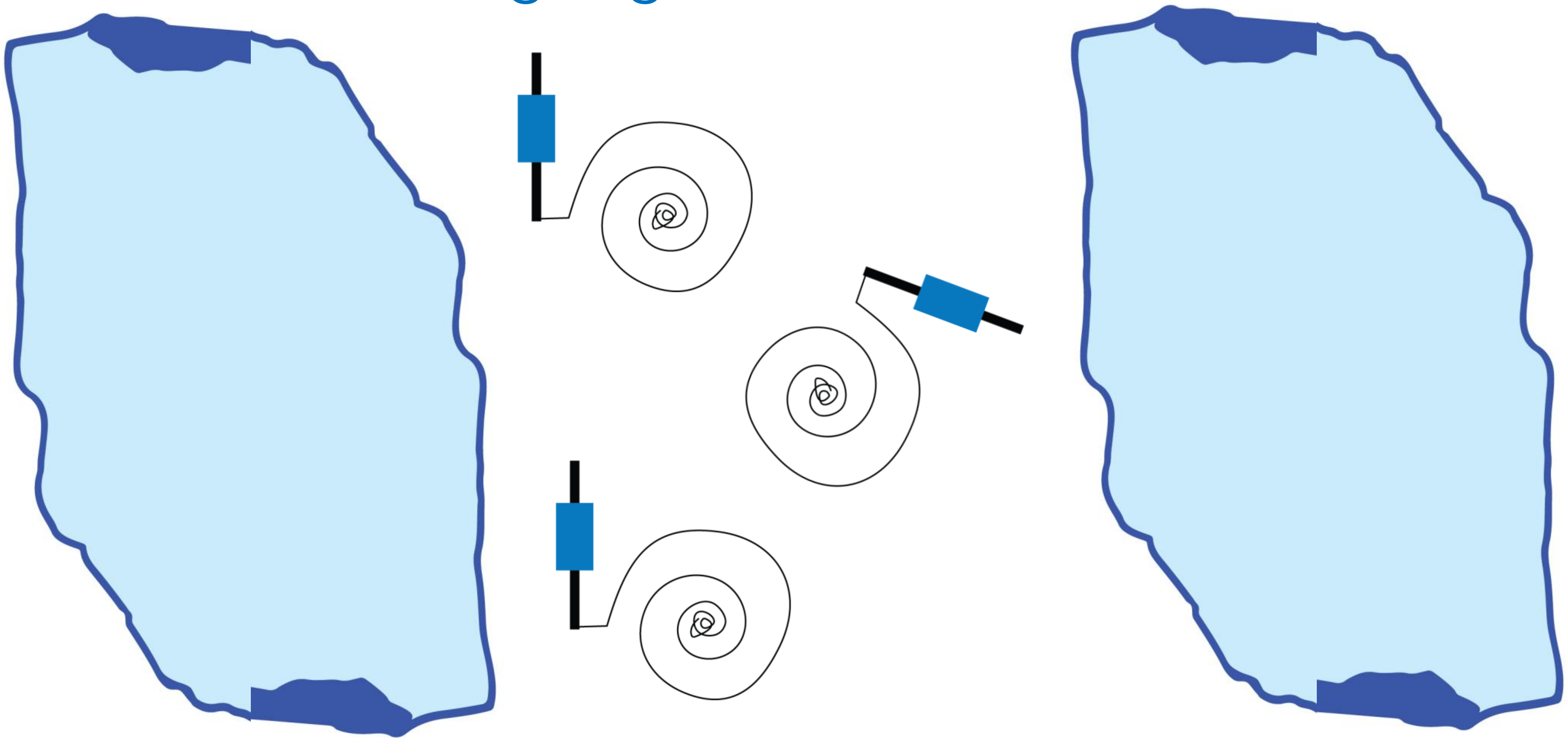
APE based Wetting Agents





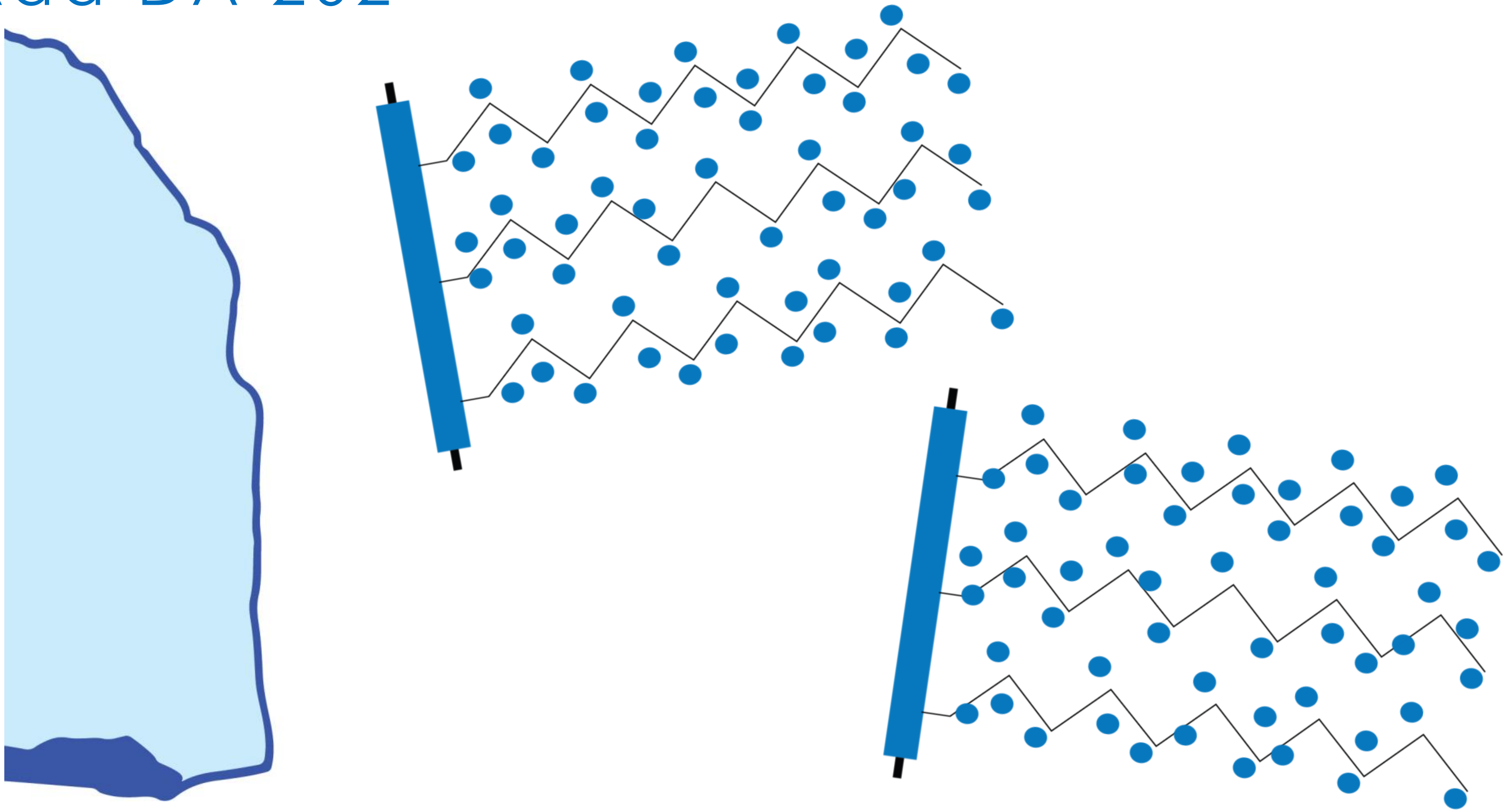
Wetting Agent – during Film Formation

APE based Wetting Agents



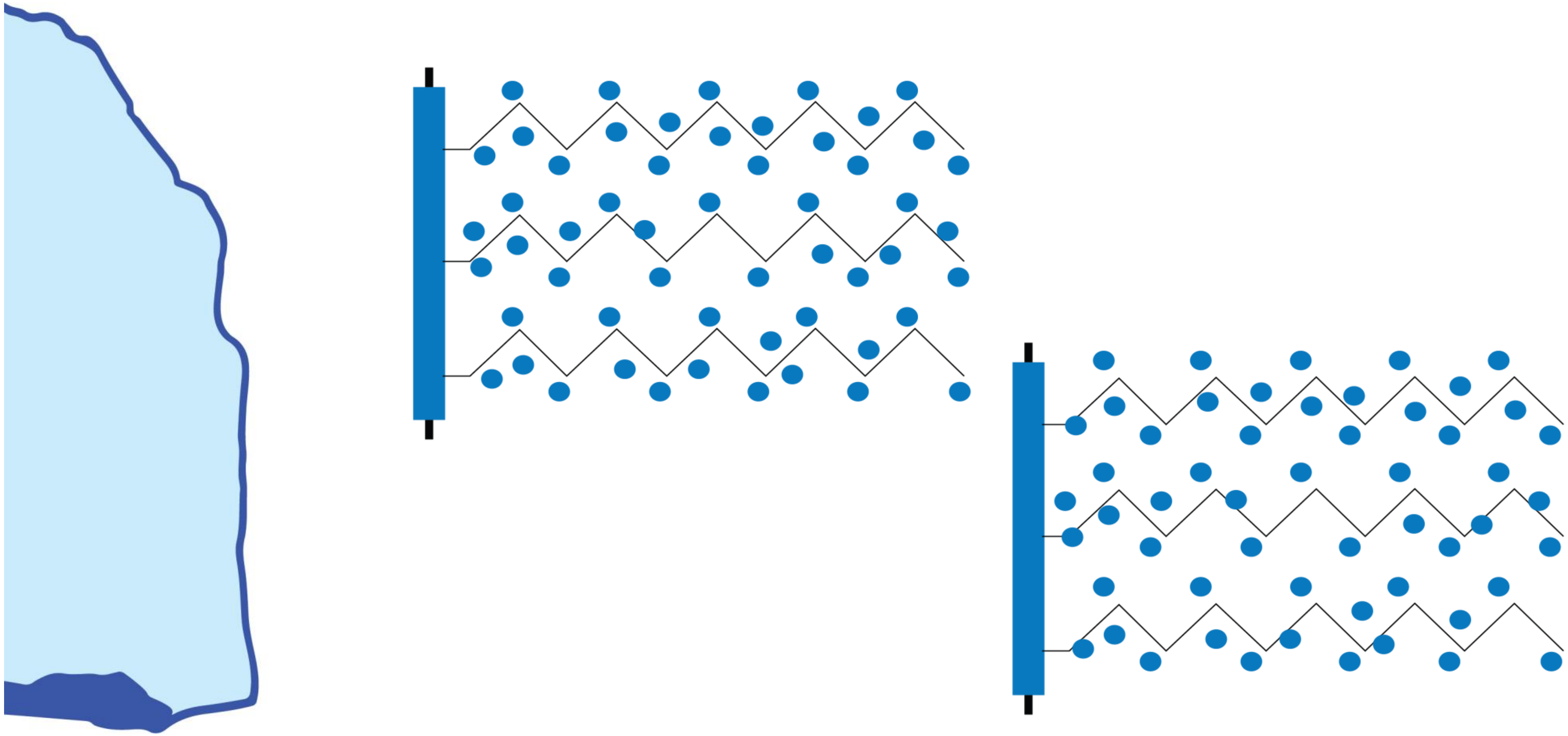
Wetting Agent – during Film Formation

Pat-Add DA 202



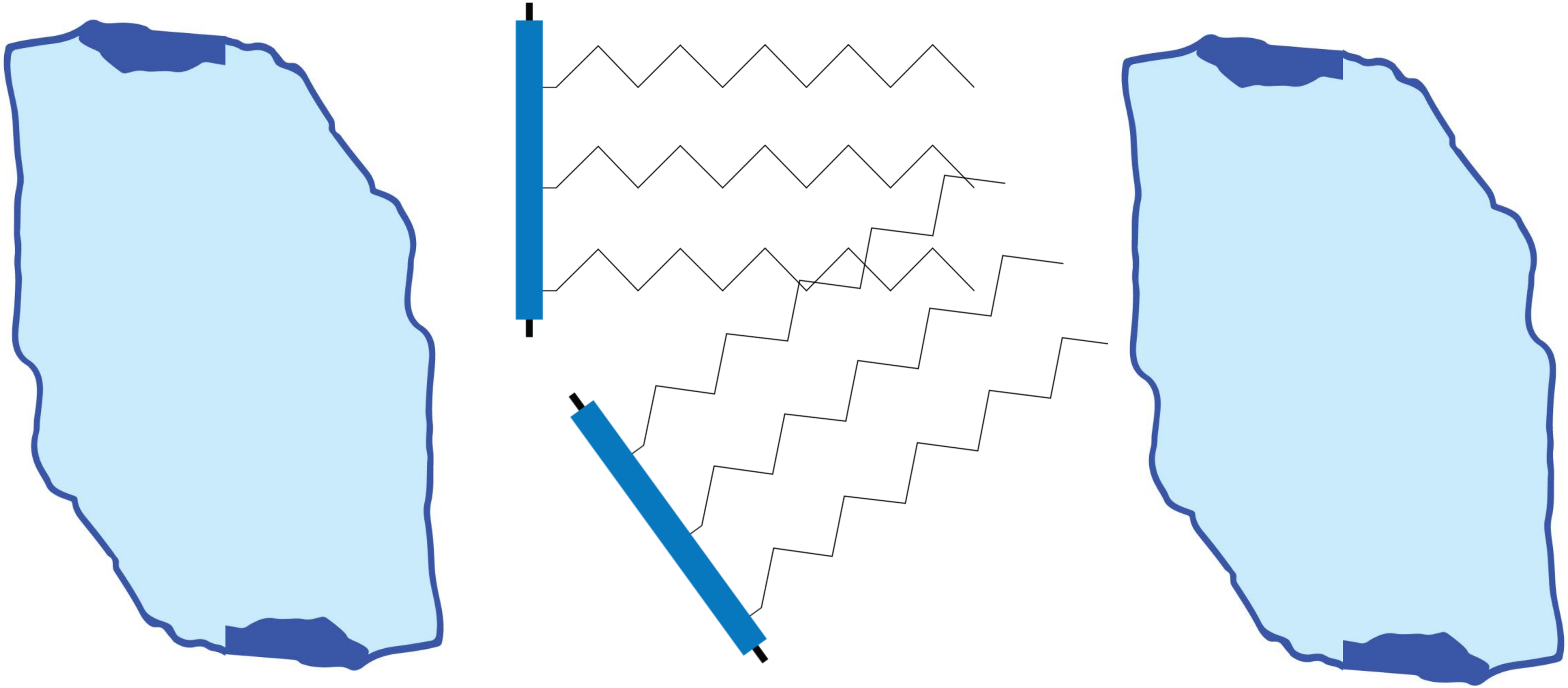
Wetting Agent – during Film Formation

Pat-Add DA 202



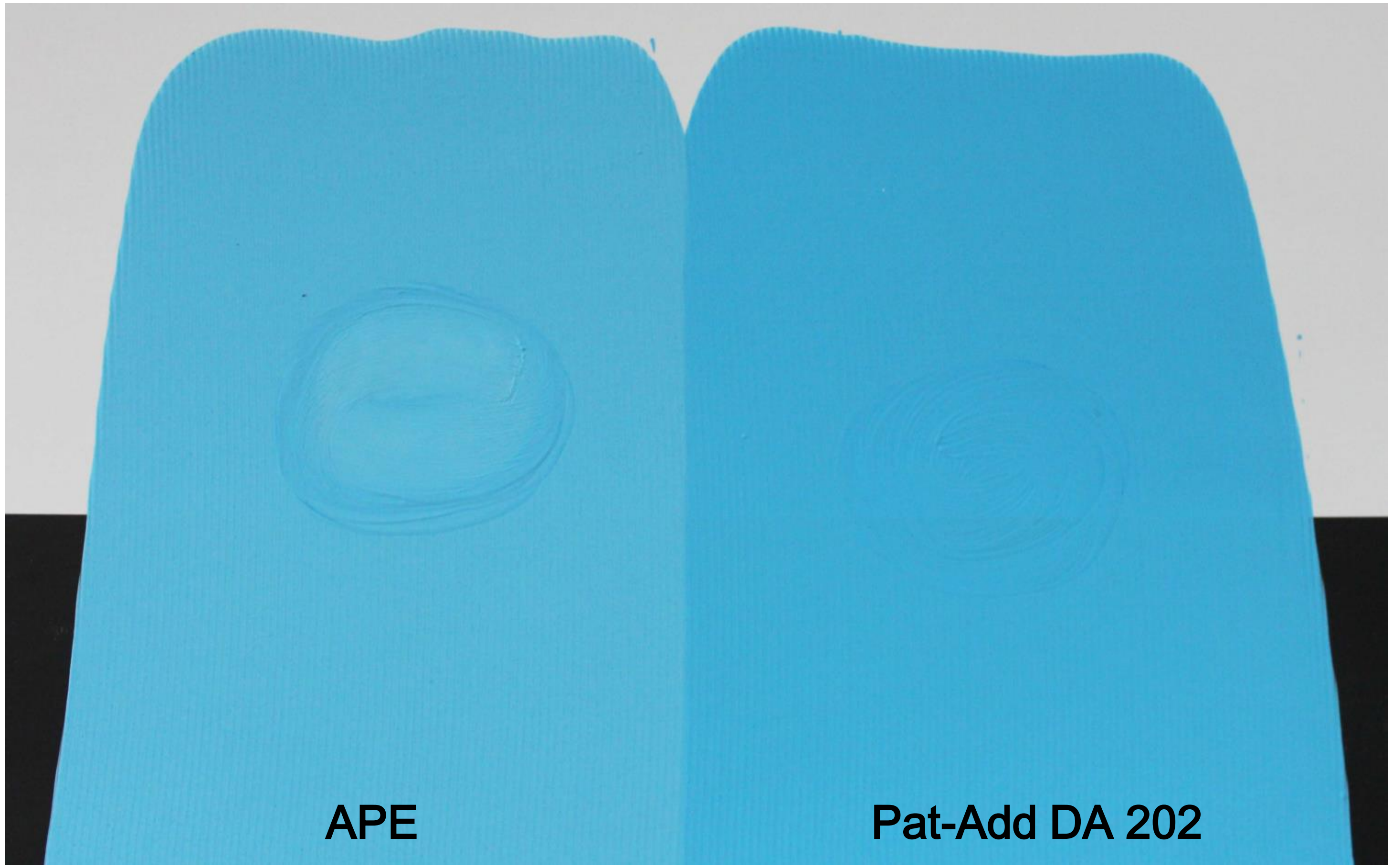
Wetting Agent – during Film Formation

Pat-Add DA 202



Resulting in Resistance to Flocculation

During shift from Aqueous to Organic during Dry



Pat-Add DA 202

APPLICATIONS

Interior Architectural Coatings

Exterior Architectural Coatings

Filler Slurries

Construction Coatings

Wood Coatings

Contents

Pat-Add DA 202

PERFORMANCE STUDY

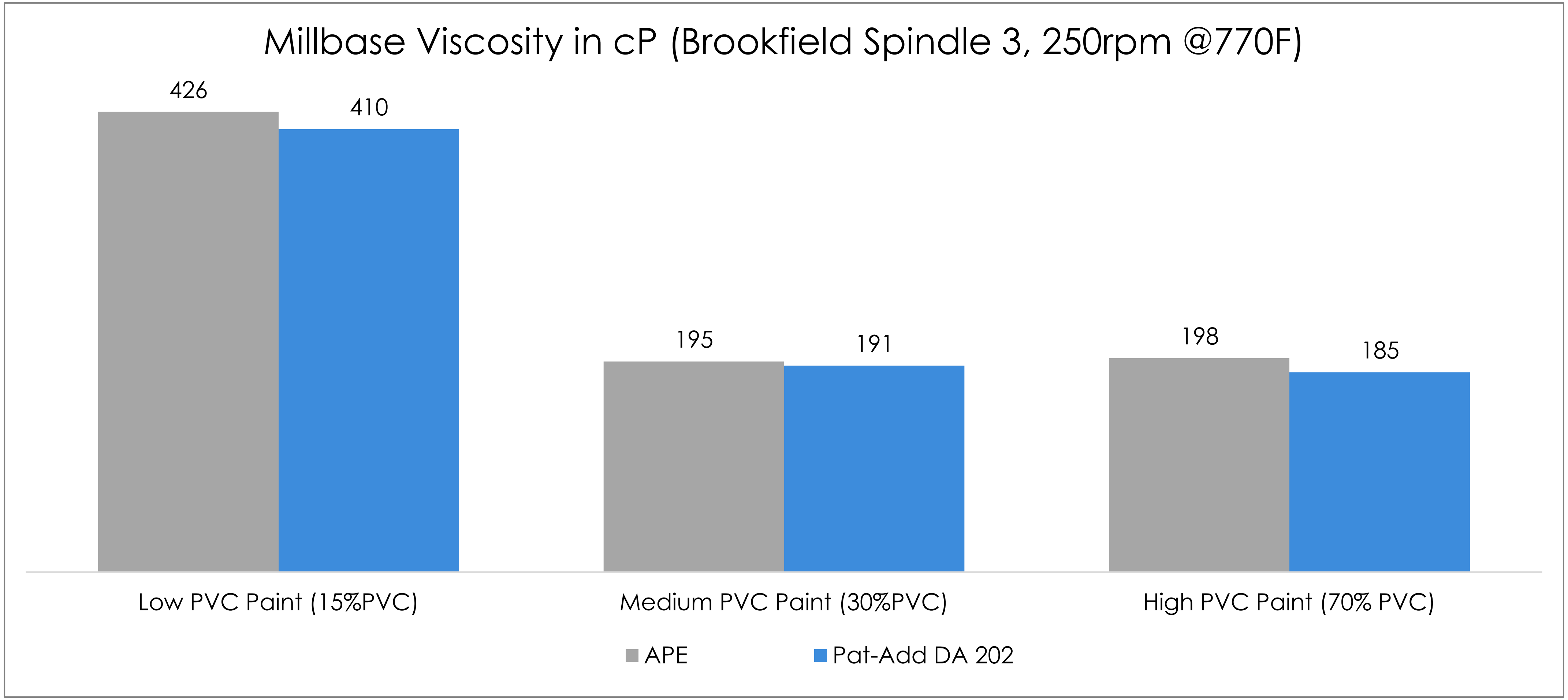
- Wetting Efficiency
- Foam Entrapment in various PVC (Acrylic Paints)
- Foam Generation in Application
- Freeze Thaw in various PVC (Acrylic Paints)
- Opacity- Contrast Ratio
- Color Stability- Flocculation
- Scrub Resistance Test
- Water Resistance Test
- Washability Test

General Formulation for Pat-Add DA 202

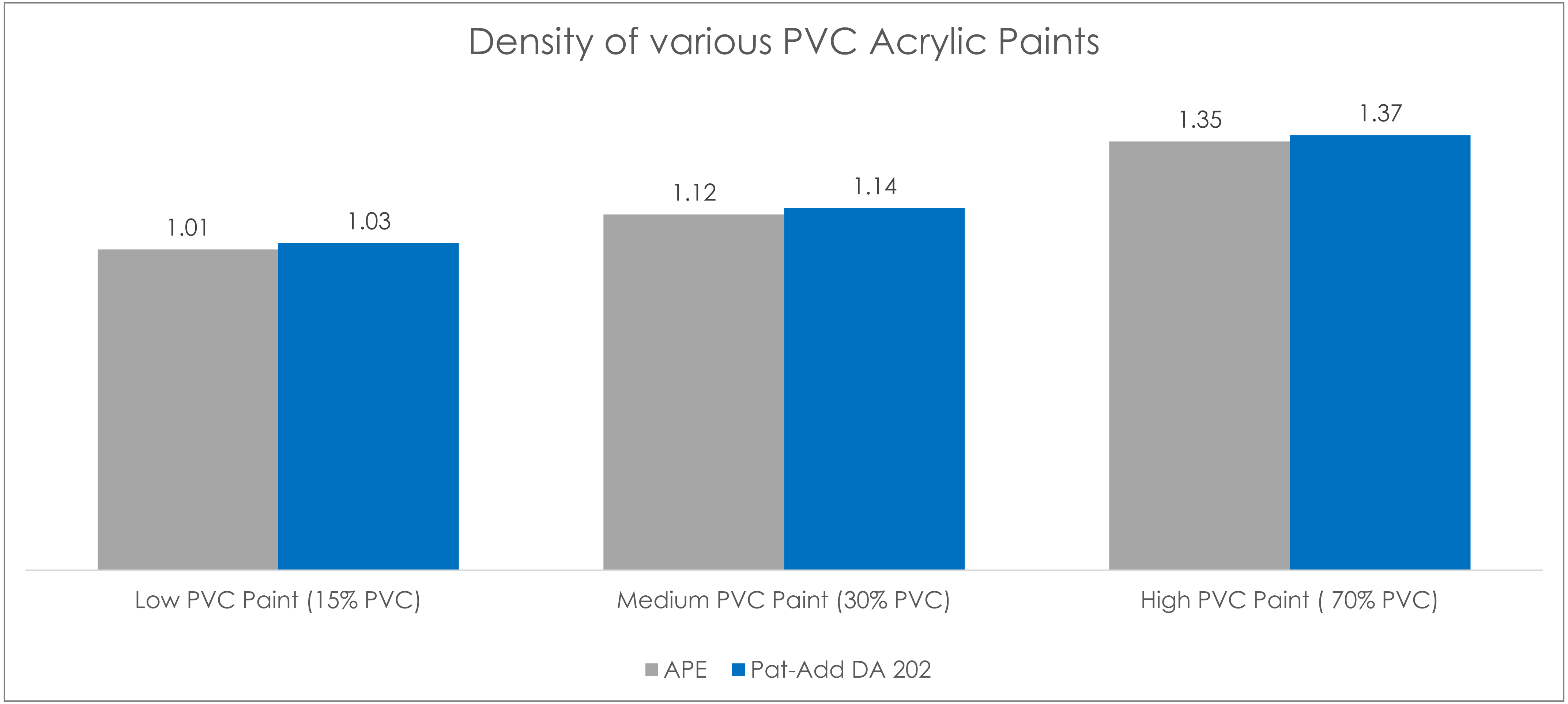
Description	Quantity	% Weight	Gal
Grind			
Water	100.0	9.63	12.00
HEC	2.0	0.19	0.17
pH regulator	0.5	0.05	0.06
Pat Add DA103	6.0	0.58	0.55
Pat-add DA 202	2.0	0.19	0.22
In-Can Biocide	1.0	0.10	0.12
Pat-Add AF 34	2.0	0.19	0.24
Attapulgite clay	2.0	0.19	0.10
Titanium Dioxide	200.0	19.26	6.00
CaCO3, 5HF	50.0	4.81	2.22
Sub-Total	365.50	35.19	21.68
Letdown			
Water	25.0	2.41	3.00
Acrylic Emulsion	400.0	38.52	45.71
Add grind to letdown			
Pat-Add AF 34	2.0	0.19	0.24
Water	211.7	20.38	25.41
ICI Thickener	30.3	2.92	3.48
Pat-Add Rheol 100	4.0	0.39	0.46
Total	1038.5	100.00	100.00

Calculation Results	
VOC g/L	0
PVC Ratio	28.13
Formula Lb / Gal	10.39
% Weight Solids (NVW)	45.29
% Volume Solids (NVV)	31.81

Wetting Efficiency

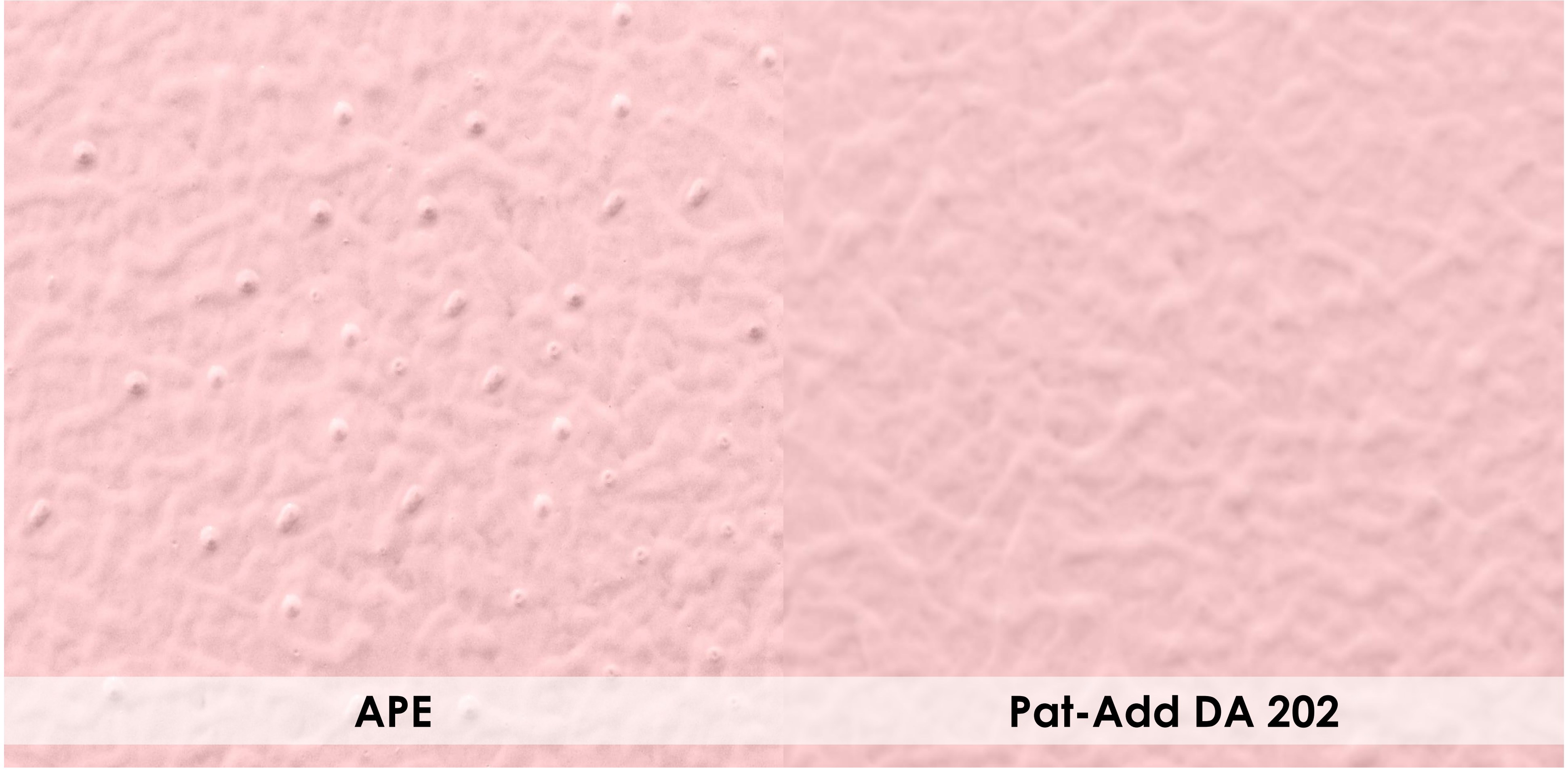


Foam Entrapment



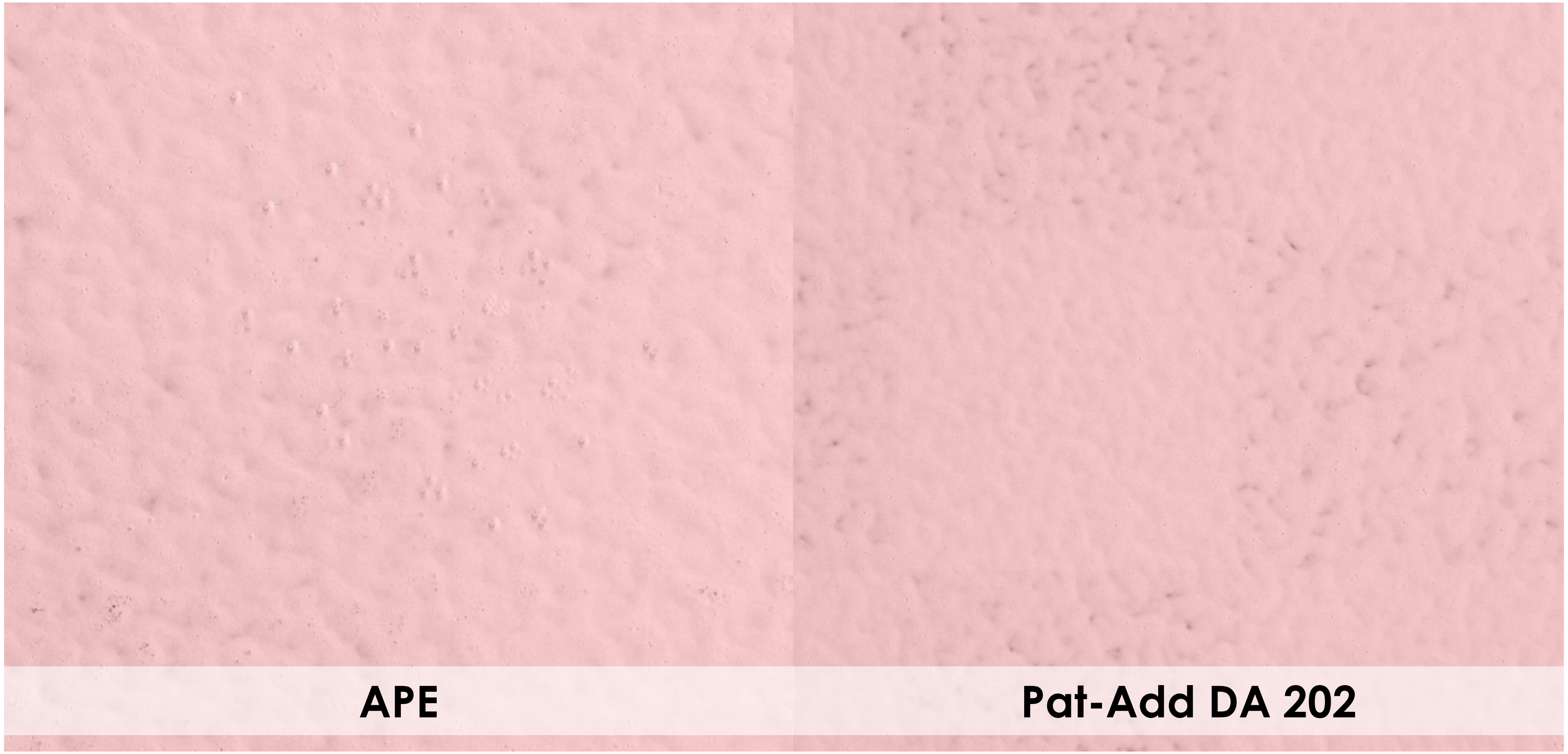
Foam Generation in Application

LOW PVC ACRYLIC EMULSION PAINT (15% PVC)



Foam Generation in Application

MID PVC ACRYLIC EMULSION PAINT (30% PVC)

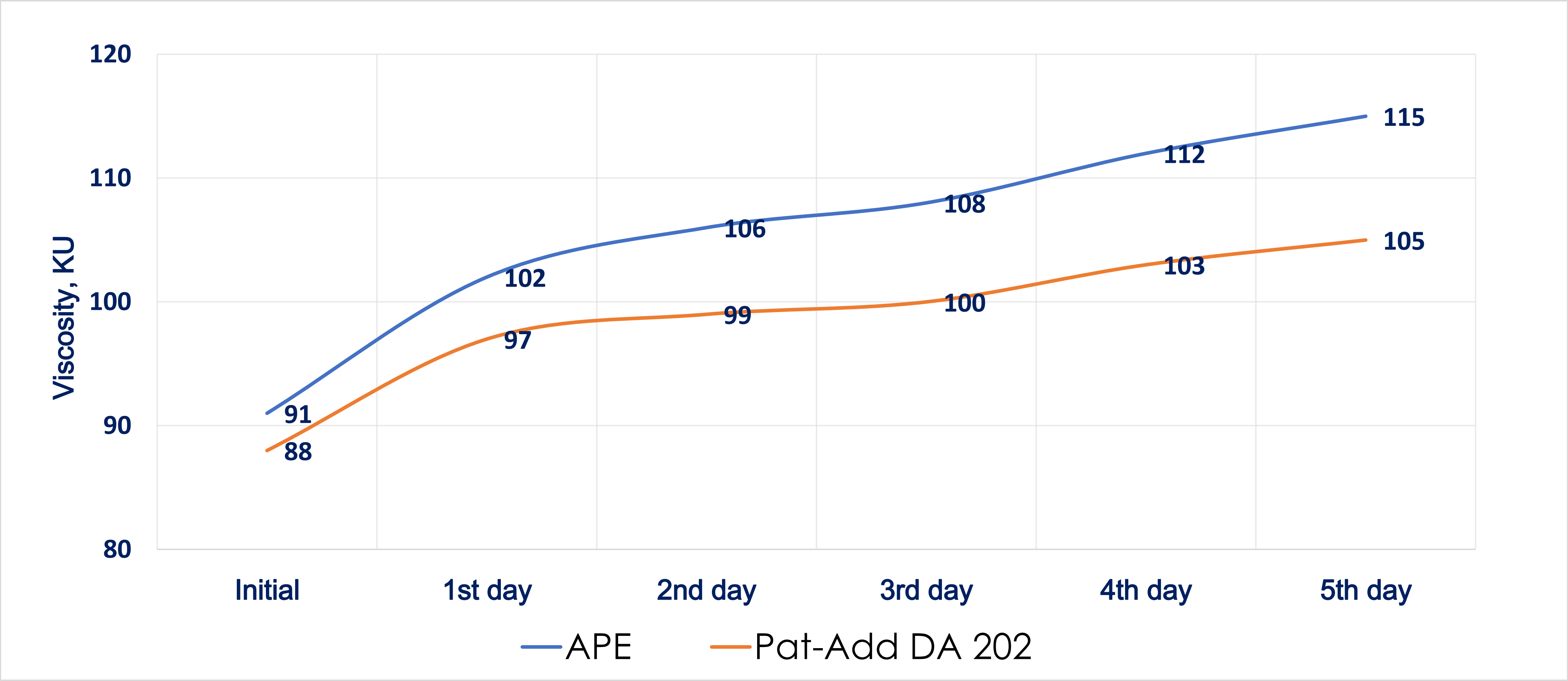


Foam Generation in Application

HIGH PVC ACRYLIC EMULSION PAINT (70% PVC)

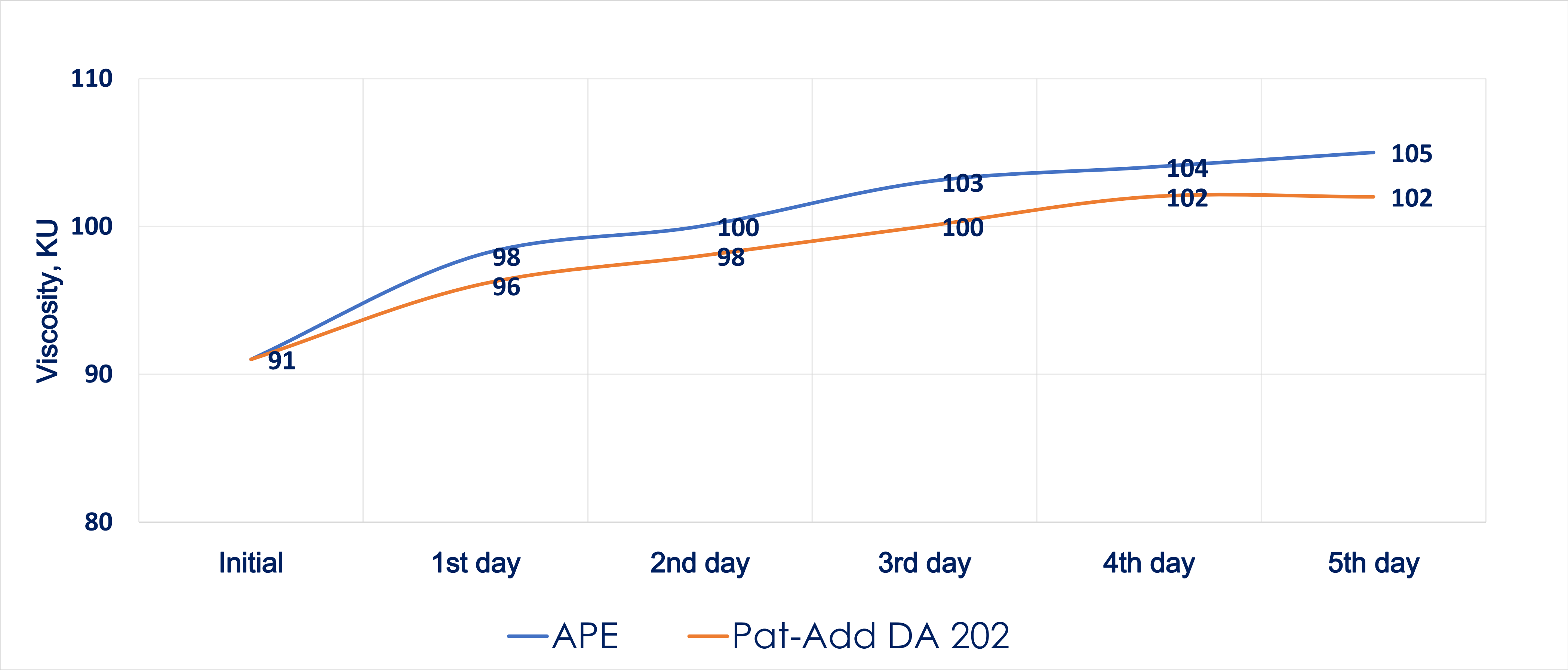
Freeze Thaw Viscosity Results

LOW PVC ACRYLIC EMULSION PAINT (15% PVC)



Freeze Thaw Viscosity Results

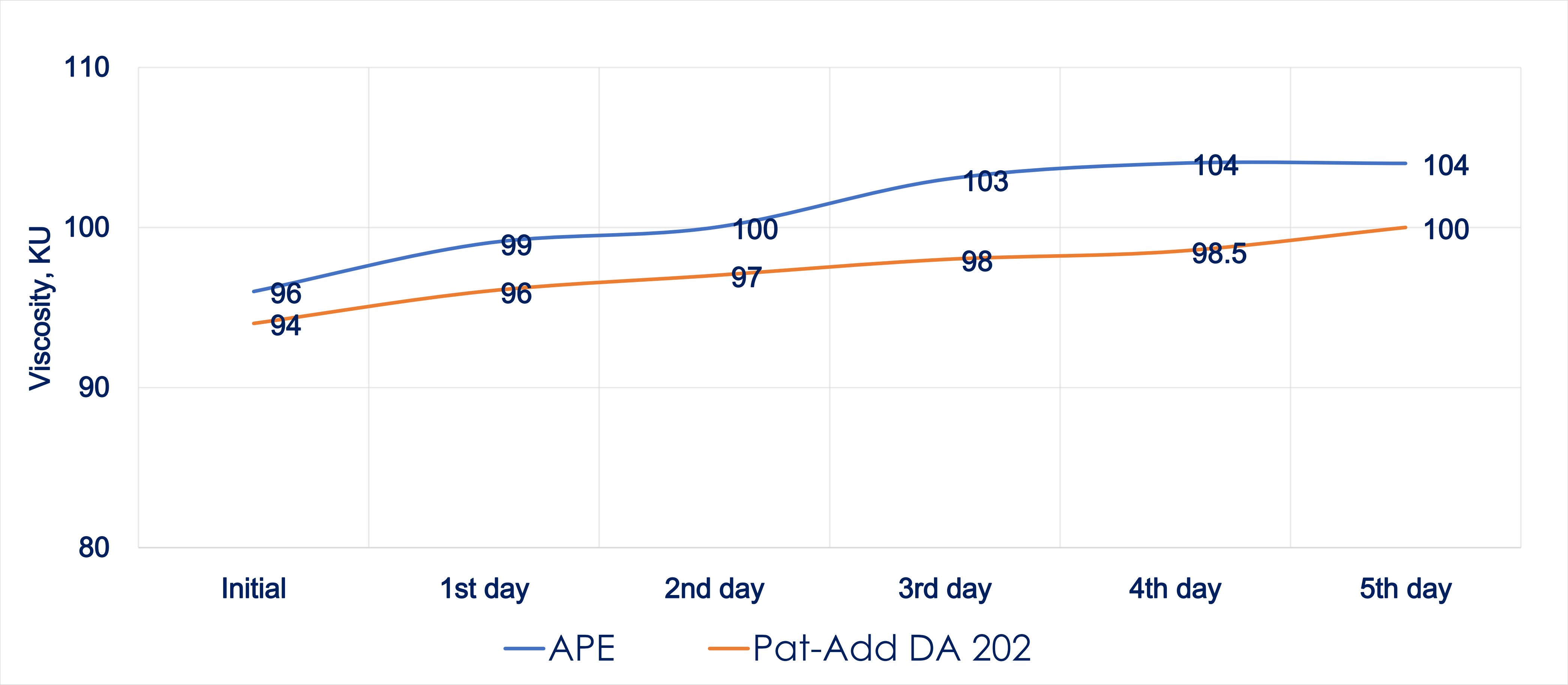
MID PVC ACRYLIC EMULSION PAINT (30% PVC)



PATCHAM (FZC)

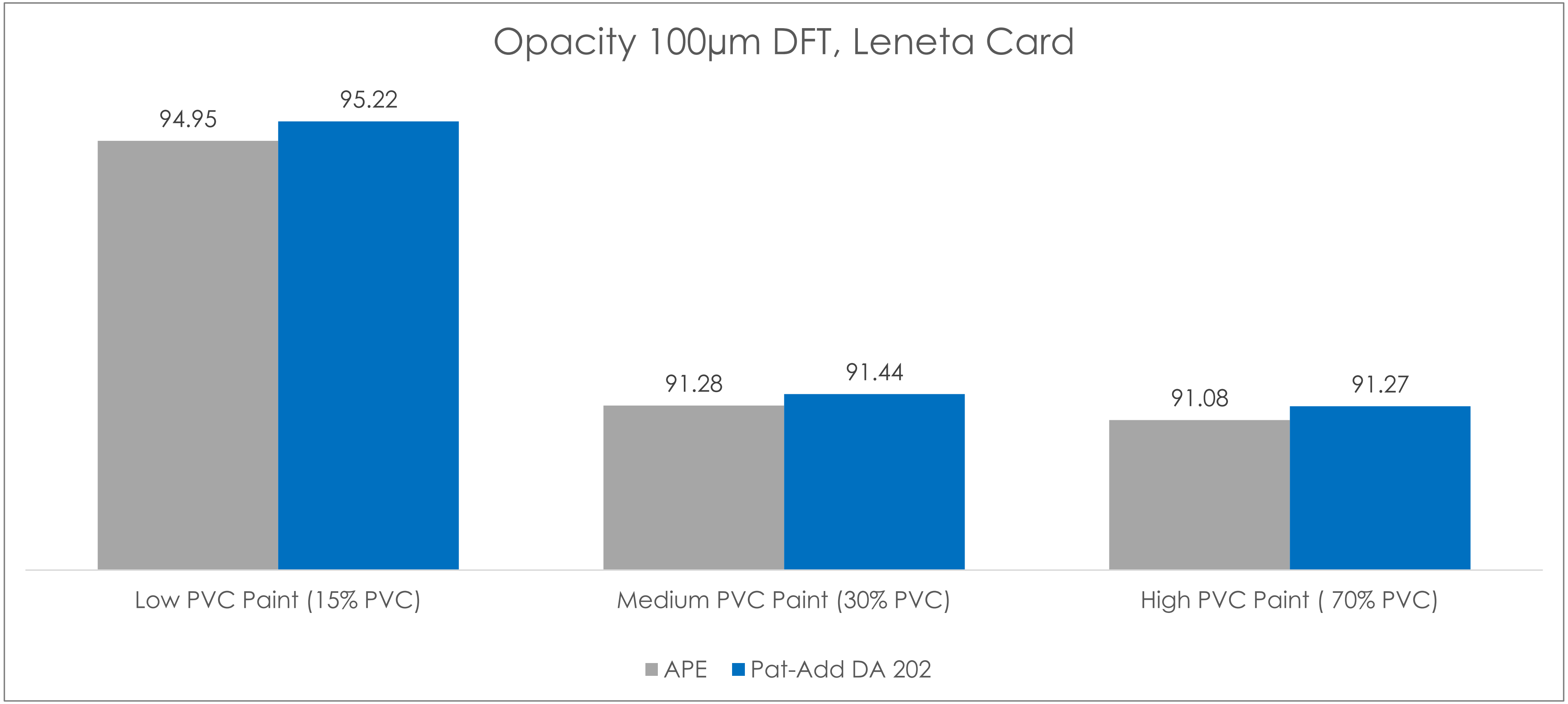
Freeze Thaw Viscosity Results

HIGH PVC ACRYLIC EMULSION PAINT (70% PVC)



PATCHAM (FZC)

Opacity / Contrast Ratio



Color Stability

30% PVC ACRYLIC EMULSION WITH 12% UNIVERSAL COLORANT GREEN

After 24 hours Storage

After 30 days Storage

After 24 hours Storage		After 30 days Storage	
APE	**Pat-Add DA 202**	**APE**	**Pat-Add DA 202**

*At Room Temperature Storage

Color Stability

30% PVC ACRYLIC EMULSION WITH 12% UNIVERSAL COLORANT BLUE

After 24 hours Storage

APE

Pat-Add DA 202

After 30 days Storage

APE

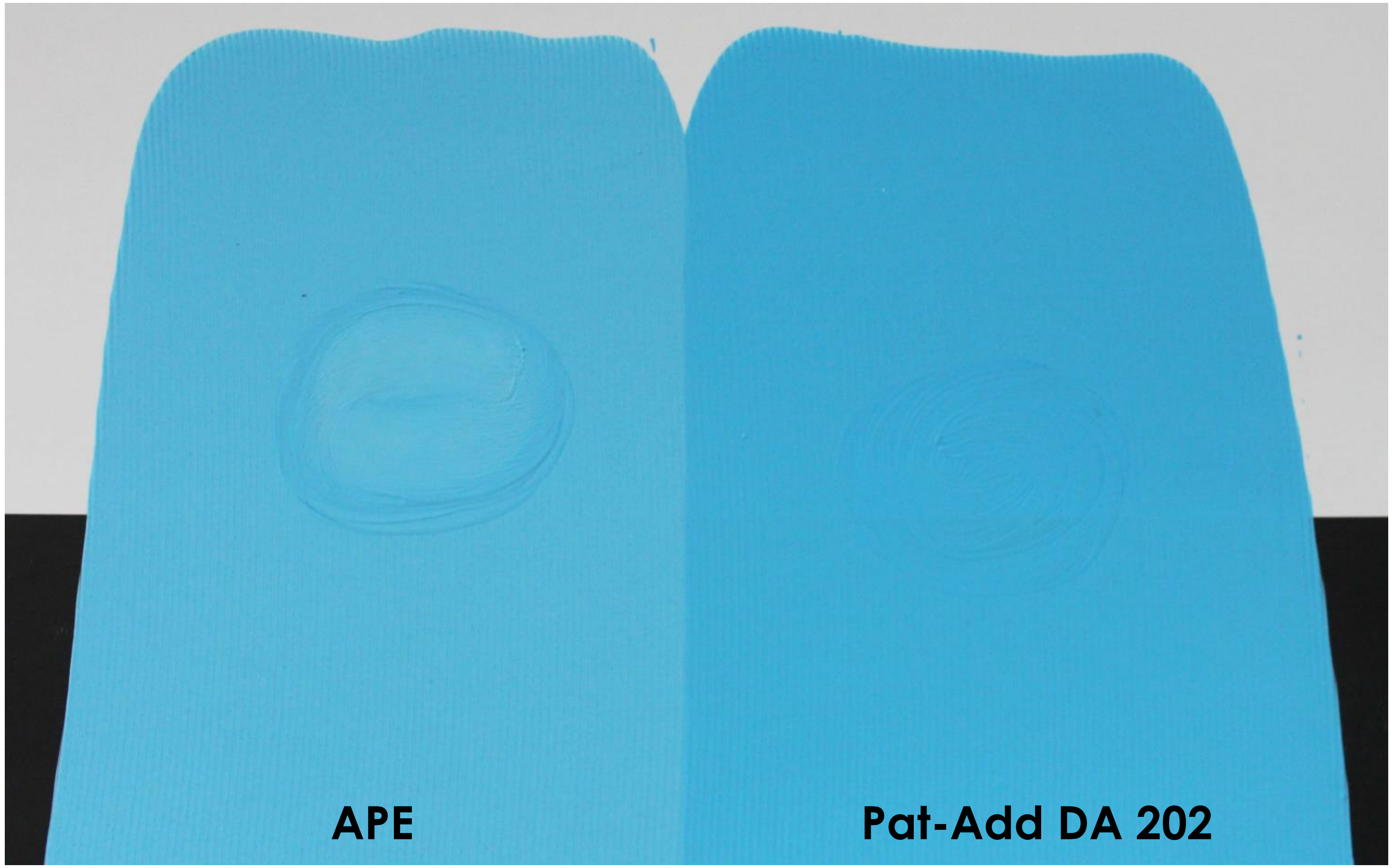
Pat-Add DA 202

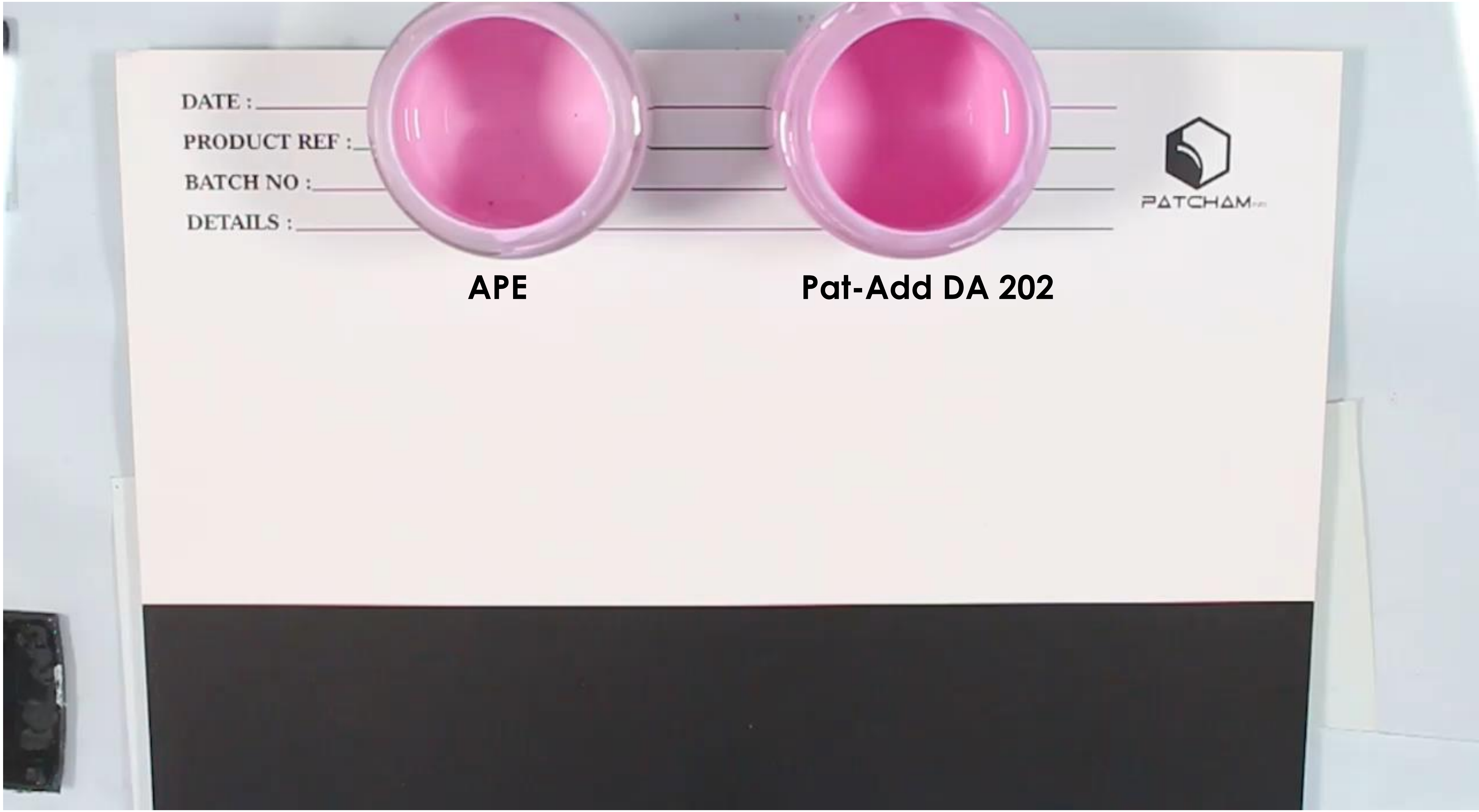
*At Room Temperature Storage

PATCHAM (FZC)

Tinting Strength and Flocculation

TINTED HIGH PVC STYRENE ACRYLIC BASE




DATE :
PRODUCT REF :
BATCH NO :
DETAILS :
PATCHAM
APE
Pat-Add DA 202

Scrub Resistance Test

HIGH PVC ACRYLIC EMULSION, 70 % PVC

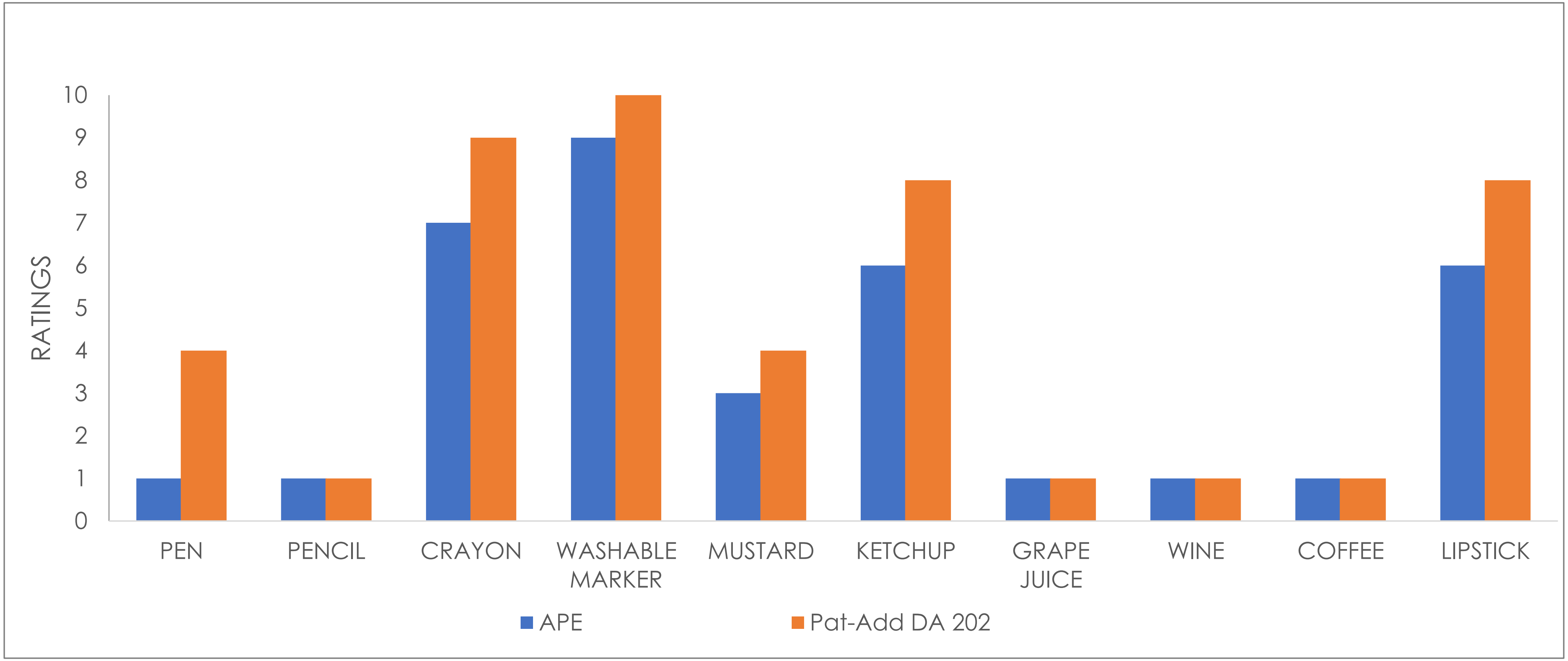
731 cycles | 1144 cycles

APE | Pat-Add DA 202

Water Resistance Test

HIGH PVC ACRYLIC PAINT (3-days Water Immersion)

Washability Test



Summary of Performance

Pat-Add DA 202 vs APE

- ☑ Wetting Efficiency
- ☑ Foam Entrapment in various PVC
- ☑ Foam Generation in Application
- ☑ Freeze Thaw in various PVC
- ☑ Opacity- Contrast Ratio
- ☑ Color Stability- Flocculation
- ☑ Water Resistance Test
- ☑ Washability Test
- ☑ Scrub Resistance Test

Contents

Conclusion

Pat-Add DA 202

- Patcham's new 3-Master technology for nonionic wetting and dispersing agents contributes to superior performance

- Applicable as drop-in alternative to APE-based wetting agents

Patcham Additives for Emulsion Paints

Pat-Add DA103

Polyelectrolyte, sodium salt-based dispersant

Pat-Add DA 202

Three-master Patcham Technology wetting agent

Pat-Add AF 34

Oil free polysiloxane based defoamer

Pat-Add Rheol 100

HEUR type rheology modifier

Other Formulations – Medium PVC

Description	% Weight
Grind	
Water	16.50
HEC	0.60
pH regulator	0.20
Pat Add DA103	0.50
Pat-add DA 202	0.40
In-Can Biocide	0.40
Pat-Add AF 34	0.30
Titanium Dioxide	12.00
CaCO3, 5HF	13.00
Sub-Total	43.9
Letdown	
pH regulator	0.10
Acrylic Emulsion	39.00
Add grind to letdown	
Pat-Add AF 34	0.10
Propylene Glycol	1.50
Water	14.00
Coalescing agent	1.20
Pat-Add Rheol 100	0.20
Total	100.00

Calculation Results	
VOC g/L	0
PVC Ratio	39.241
Formula Lb / Gal	10.06
% Weight Solids (NVW)	45.48
% Volume Solids (NVV)	49.98

Other Formulations – High PVC

Description	% Weight
Grind	
Water	28.85
HEC	0.70
pH regulator	0.20
Pat Add DA103	0.60
Pat-add DA 202	0.40
In-Can Biocide	0.25
Pat-Add AF 34	0.20
Titanium Dioxide	8.00
CaCO3, 5HF	37.00
Sub-Total	76.20
Letdown	
Acrylic Emulsion	14.00
Add grind to letdown	
Pat-Add AF 34	0.10
Propylene Glycol	0.20
Water	8.55
Coalescing agent	0.75
Pat-Add Rheol 100	0.20
Total	100.00

Calculation Results	
VOC g/L	0
PVC Ratio	69.39
Formula Lb / Gal	10.001
% Weight Solids (NVW)	52.92
% Volume Solids (NVV)	22.91

Disclaimer

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