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Amino Amyl Alcohol – A Next-Generation Multifunctional Additive and Co-dispersant for Paints and Coatings

Dr. Saadane REZAIGUIA

Advancion

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Introduction to Advancion
(Formerly ANGUS Chemical Company)

- **Solutions-driven** manufacturer of **multifunctional additives**, intermediates and solvents for a broad range of applications and markets
- **Extensive track record of industry innovation** and technical applications development built over 70 years
- **Dual-source manufacturing** major product lines to ensure global supply security
- 6 Regional **Customer Application Centers** to address local customer needs
- Strong focus on **Responsible Care®** and product stewardship to support the emerging trends of tomorrow

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Building on Our Legacy of High-Performance Additives for Paints and Coatings

- Advancion's commitment to innovation extends beyond new application development and is increasingly focused on new product / molecule development and commercialization

- Our goal is to provide manufacturers and formulators with improved sustainability and performance benefits
  - **TRIS AMINO™** for indoor air quality improvement applications formaldehyde scavenging active surface coatings
  - **DMMOPA** multifunctional formulating ingredient for industrial coatings

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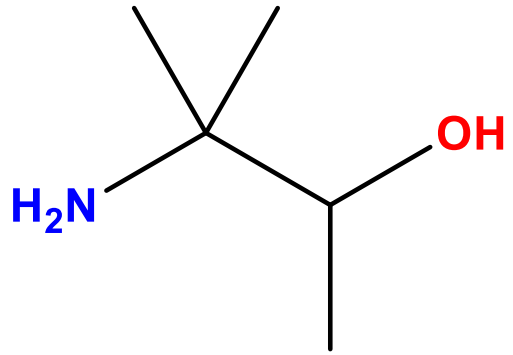
Introducing Amino Amyl Alcohol Multifunctional Additive

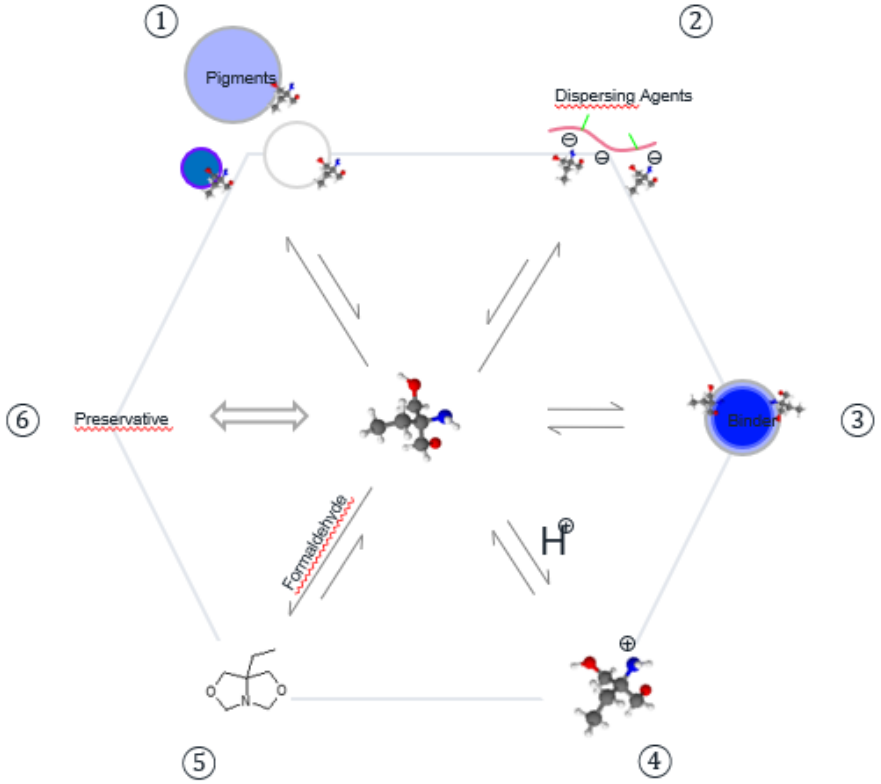
Amino Amyl Alcohol (AAA) is a readily biodegradable multifunctional additive that provides next-generation performance with an excellent safety profile



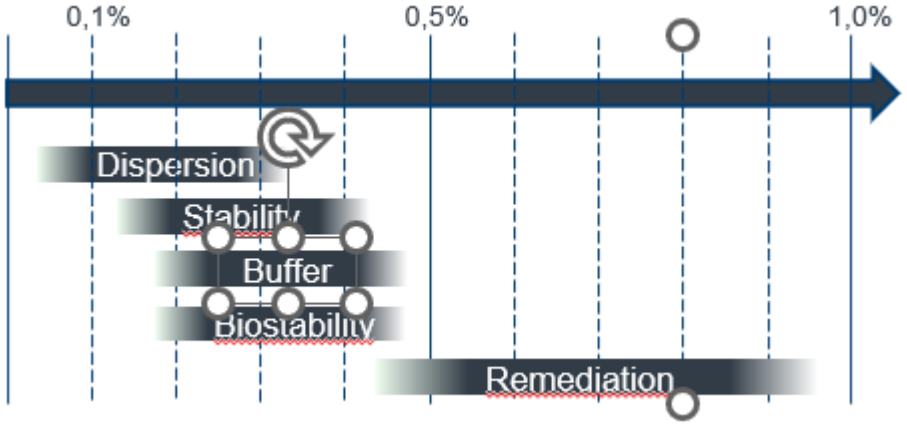
Aminoamyl alcohol

CAS No. 13325-14-9

Multifunctional Performance of Alkanolamines



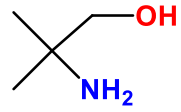
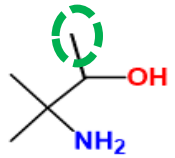
Effect	Cause	Dispersion	Let Down
Dispersion	①②	X	
Stability	①②③④	X	X
Buffer	④		X
Remediation	⑤		X
Biostability	⑥	X	X



A New-to-World Multifunctional Additive and Co-Dispersant for Paints and Coatings

AAA multifunctional additive sets **a new standard for multifunctional performance** with enhanced benefits compared to AMP

- Exceptional **pigment dispersion**
- Improved **hiding, gloss, scrub- and corrosion-resistance** across a variety of coatings applications
- **Low volatility** with an excellent EH&S profile Excellent **pH stability and microbial resistance** when used in conjunction with registered biocides
- Long-term strategy includes launching a ~40% bio-based grade, pending successful commercialization and overall market demand

	2-Amino-2-Methyl-1-Propanol	AminoAmyl Alcohol
Structure		
Reference	AMP	AAA
CAS No.	124-68-5	13325-14-9
MW	89.1	103.2
pKa	9.8	9.9
pH of 0.1 M	11.3	11.6

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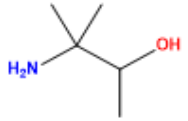
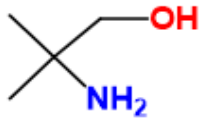
Selecting the Right Wetting and Stabilizing Agents

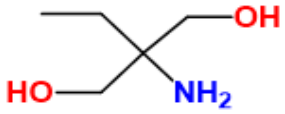
AAA NEW
AminoAmyl Alcohol



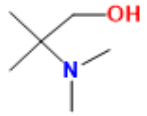
AMP
2-Amino-2Methyl Propanol



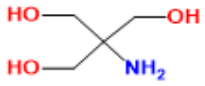
AEPD
2-Amino-2-Ethyl-1,3-PropaneDiol



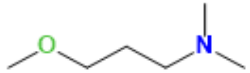
DMAMP
2-DiMethylAmino-2-MethylPropanol



TRIS AMINO
tris(hydroxymethyl)aminomethane



DMMOPA NEW
N,N-
DiMethylMethoxyPropylAmine



Decorative Paints

- ❑ Dry opacity (TiO_2 dispersion)
- ❑ Color development
- ❑ Microbiological stability
- ❑ No Yellowing effect
- ❑ Low odor

Industrial Coatings

- ❑ Salt spray improvement
- ❑ Dry opacity
- ❑ Chemical/water resistance
- ❑ Microbiological stability
- ❑ Catalyst and hardener for 2K systems
- ❑ UV and Thermal stability

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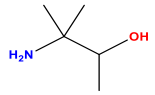
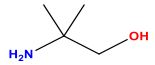
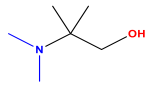
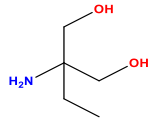
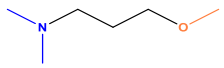
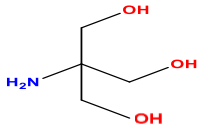
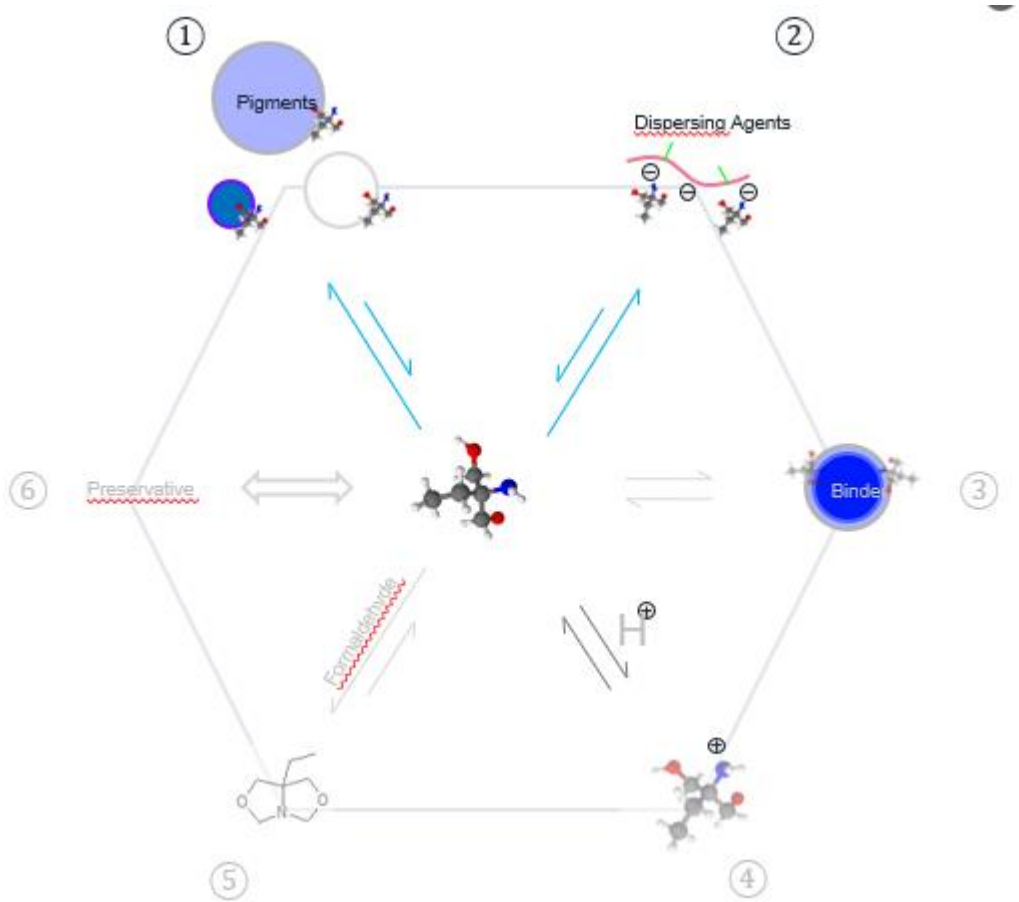
High-Performance Advancion Ingredients for Paints and Coatings

	MW (g.mol-1)	Active ingredient (%)	pKa @ 25°C	pH of 1% solution	Boiling point (°C)	Azeotrope with water	Flash point (°C)	Density @ rt
	**AAA**	**103.2**	**95%**	**9.9**	**11.6**	**159**	**No**	**76**	**0.910**
	**AMP**	89.13	95%	9.7	11.69	165	No	85.6	0.934
	**DMAMP**	117.19	80%	**10.2**	11.90	160	**Yes**	67	0.950
	**AEPD**	119.16	85%	8.8	10.98	**283**	No	>100	1.080
	**DMMOPA**	117.19	100%	9.4	NA	122	**Yes**	20	0.813
	**TRIS AMINO**	121.10	100%	8.1	10.4	**>300**	No	>100	1.350

Maximizing Multifunctional Performance



1. TiO_2 dispersion
    1. Adsorption
    2. Dispersant demand curve
    3. Dry opacity

2. Anti-corrosive pigments
    1. Particle size
    2. Salt spray improvement

3. Organic pigments
    1. Adsorption
    2. Viscosity Drop
    3. Color strength

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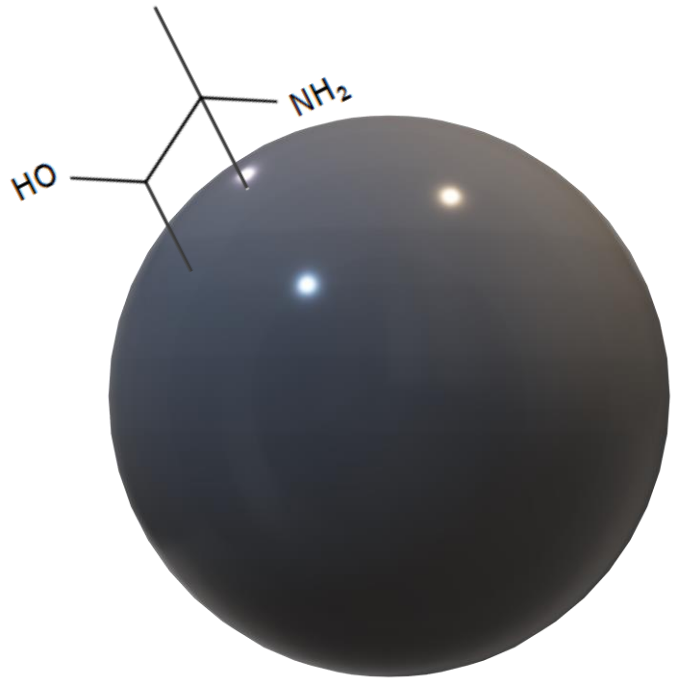
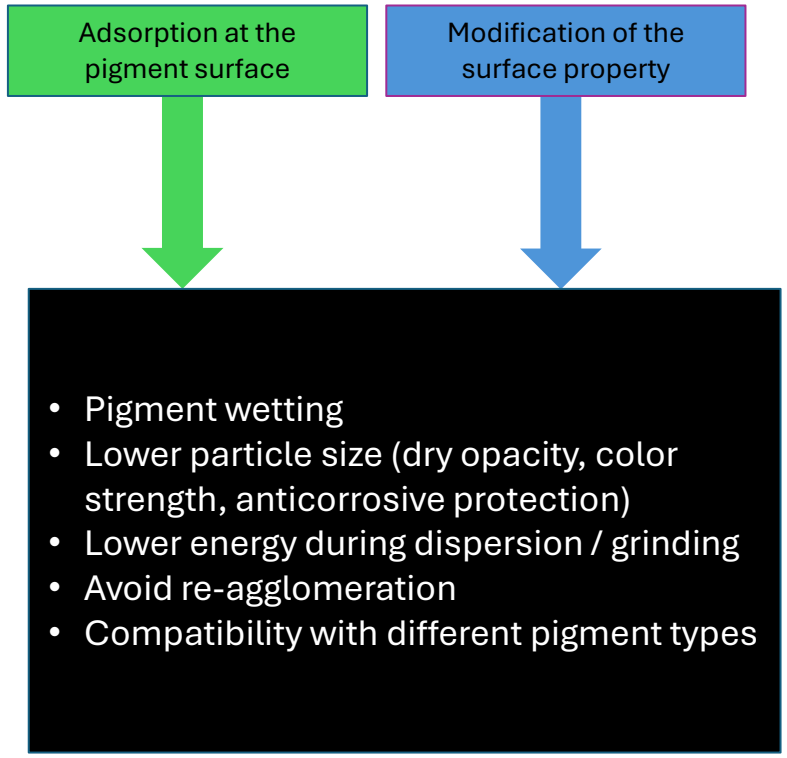
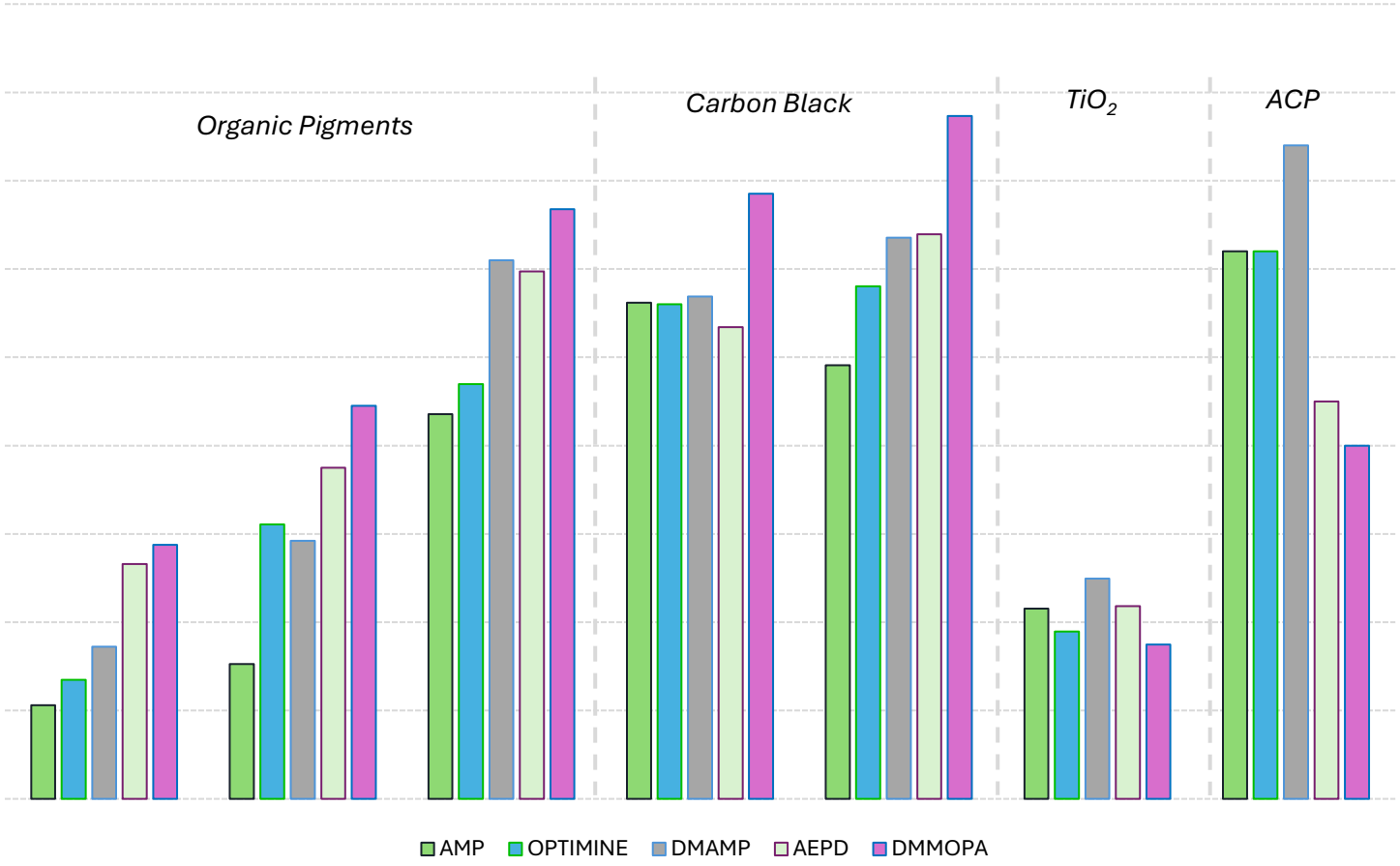
Driving Forces Behind Pigment Dispersion Performance





Adsorption at the Surface of Pigments



- **AAA shows equivalent affinity with several organic pigments compared to AMP**
- **The adsorption is linked to the wetting property of the additive, but not the tinting strength**

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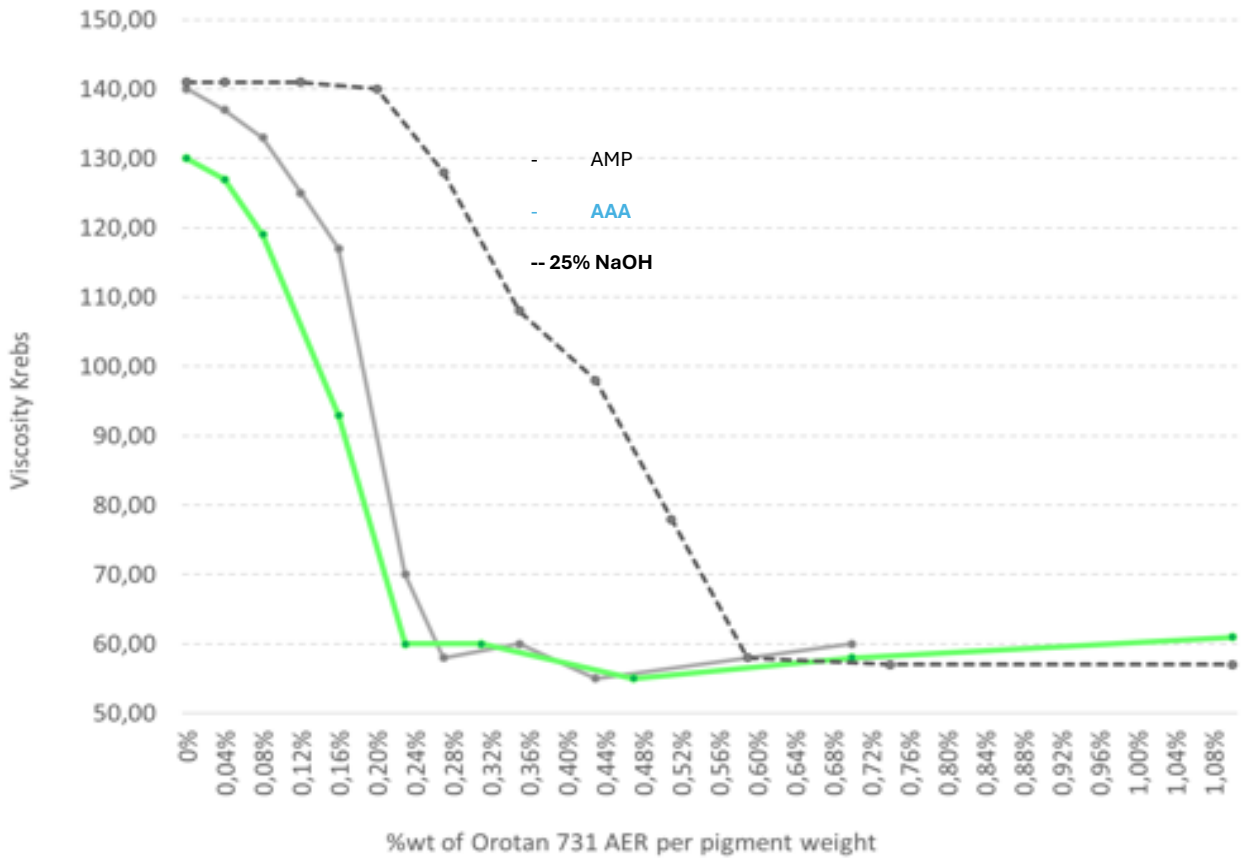
Performance Evaluation of AmineAmyl Alcohol in TiO_2 Dispersion

Exceptional TiO_2 Co-Dispersion

Dispersant demand curve of KRONOS* 2190 with OROTAN* 731 in presence of 0.05 wt% of amino alcohols



- AmylAmyl Alcohol « AAA » is the first standalone amino alcohol additive with improved co-dispersion performance versus AMP
- Enables formulators to optimize TiO_2 loading levels while reducing use of other ingredients, such as primary dispersants, to reduce overall formulation costs
- Demonstrates potential to reduce loading levels of primary dispersants up to ~40%, depending on the individual formulation

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In-Depth Architectural Paint Evaluation

- Methodology based on a Design of Experiment (DoE)
- 16 formulations for each additive, with 5 variables
- Comparision between all AAA, AMP, and other Advancion additives)
- Extensive DOE approach minimizes variability of conditions

BY THE NUMBERS

- **32 months** of lab work
- **134 formulations** = 134 L of coatings
- **235 hours** of paint preparation
- **804 draw downs**
- **12,664 measurements**

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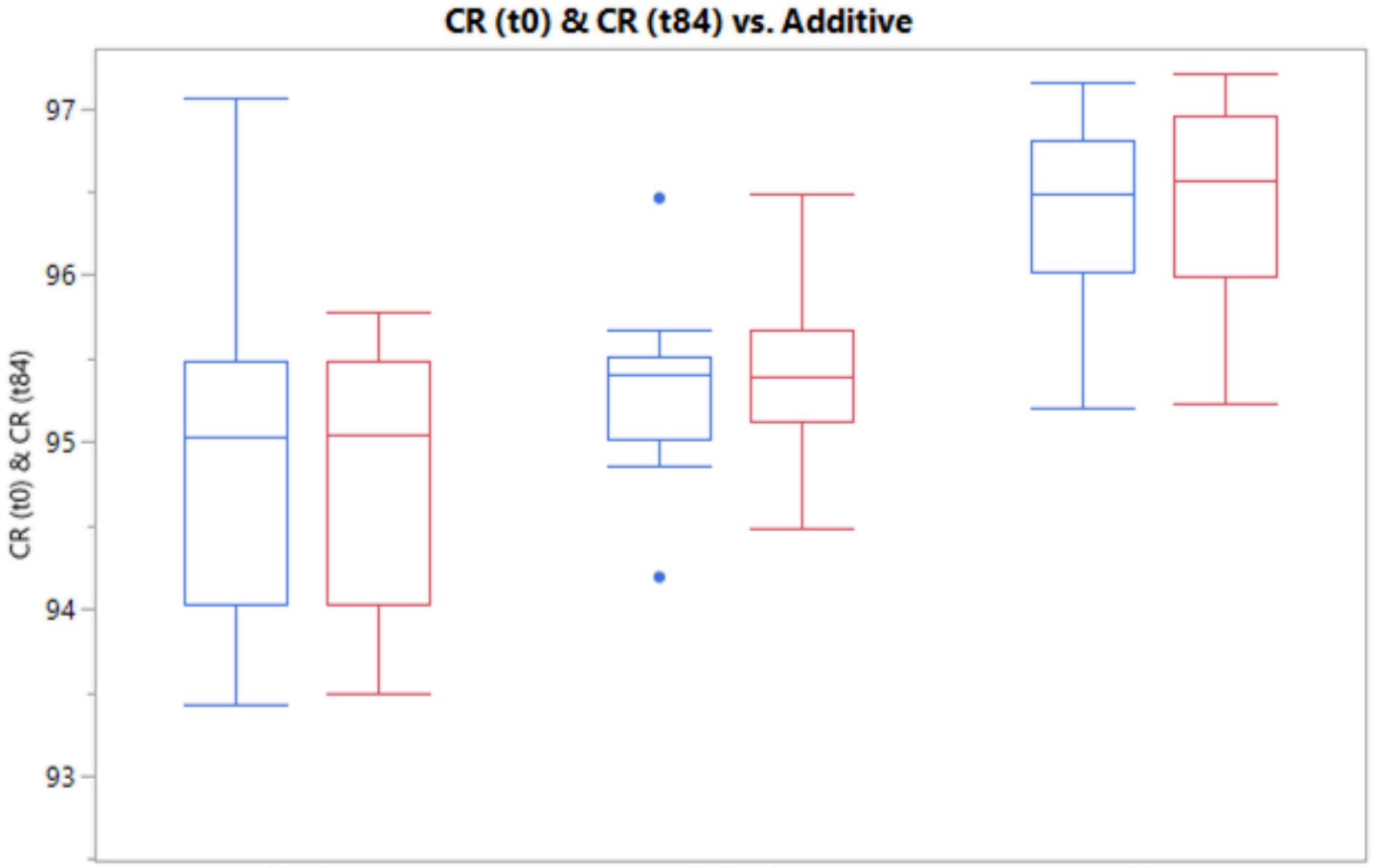
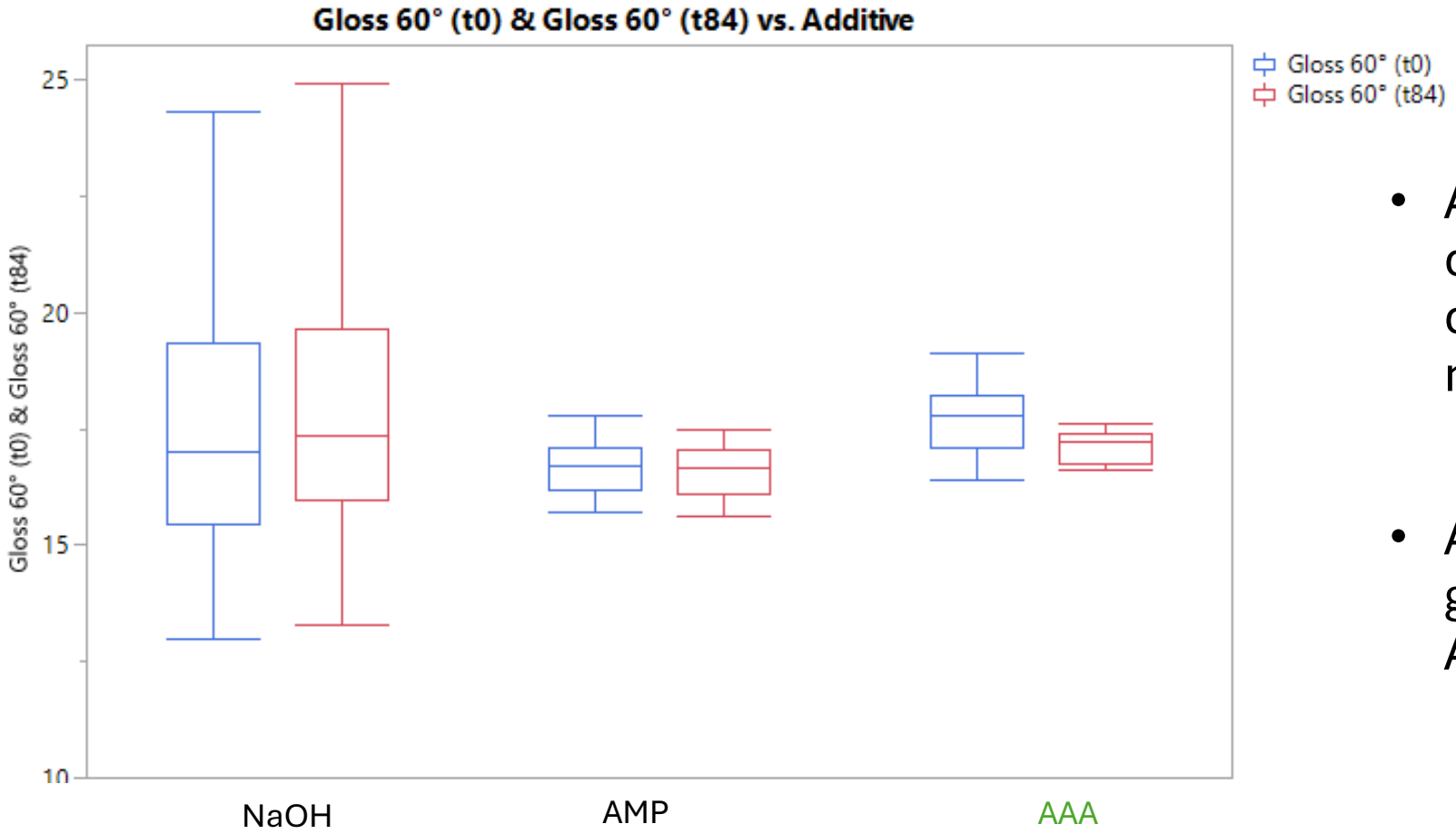
Hiding Power - Initial and After 3 Months at Room Temperature



- AAA improves hiding in the finished paint formulations evaluated versus AMP

Gloss at 60° After 3 Months at Room Temperature



- AAA and AMP show more consistent results compared to the control neutralizer
- AAA shows higher initial gloss when compared to AMP

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Performance Evaluation of AminoAmyl Alcohol in Waterborne Metal Coatings

In-Depth Waterborne Metal Coatings Evaluation

- Waterborne metal coatings formulations developed and evaluated using different combinations of amino alcohols and anti-corrosion pigments

- Anti-corrosion pigments used:

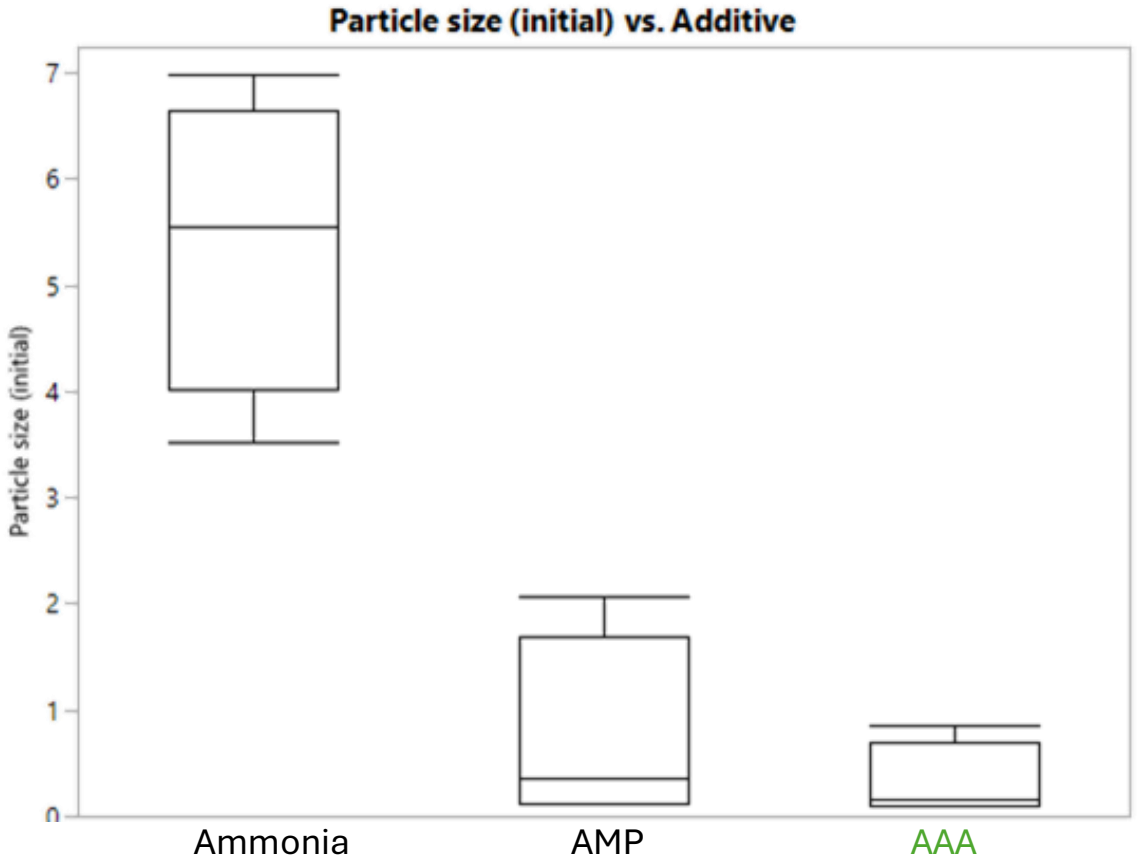
  ZP: zinc phosphate

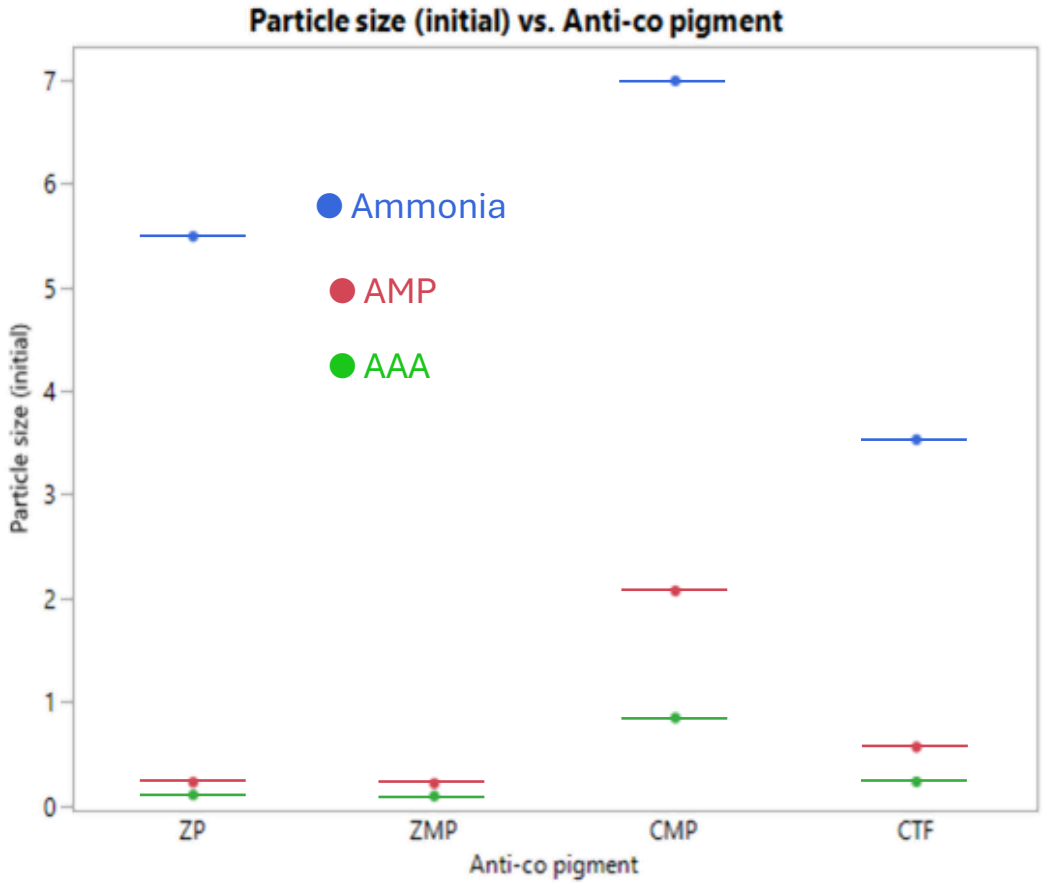
  ZMP: zinc molybdenum orthophosphate

  CMP: calcium magnesium orthophosphate

  CTF: calcium modified silica gel

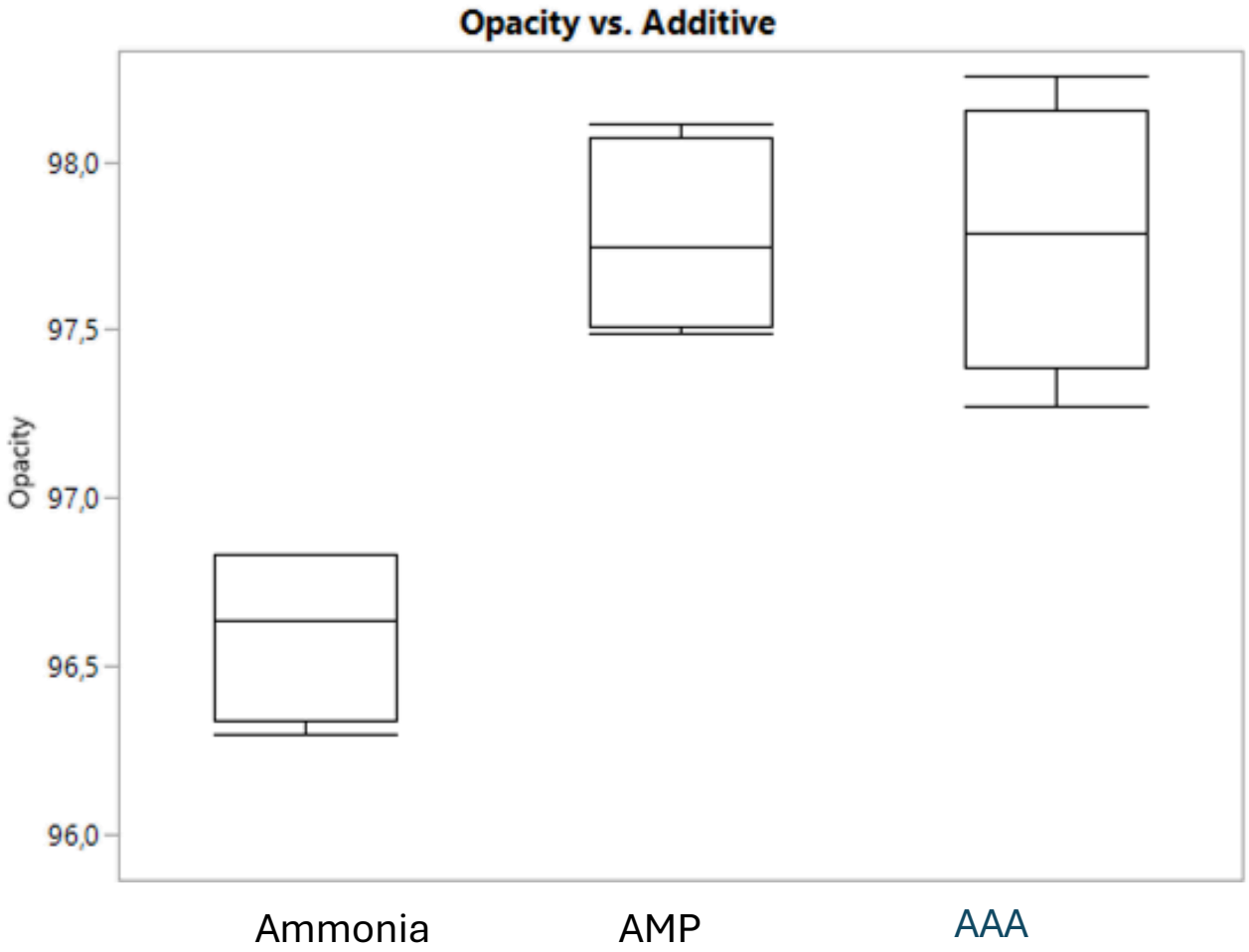
Particle Size (µm) of Anti-Corrosion Pigments





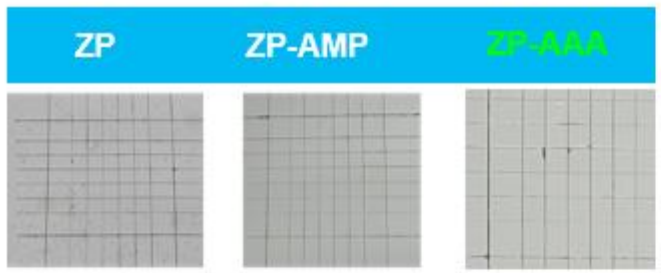
- **Similar to other Advancion amino alcohols, AAA provides outstanding wetting of commonly used anti-corrosion pigments** s

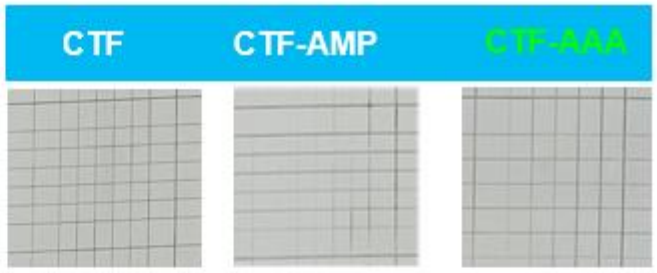
Hiding Power / Opacity

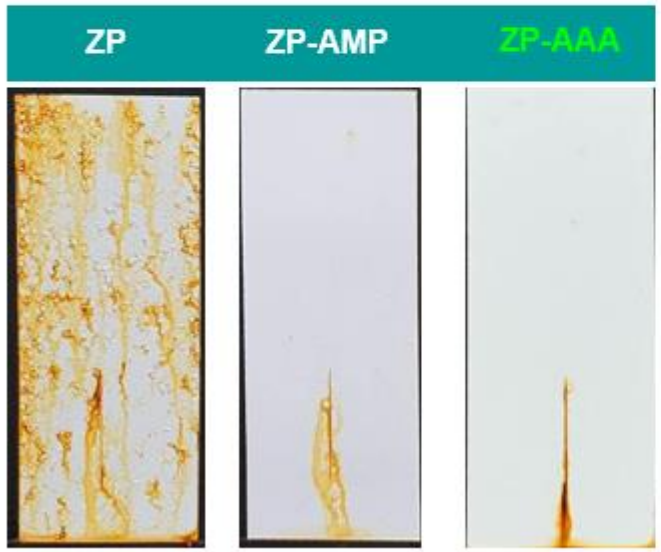


- AAA shows slightly improved hiding in the finished paint formulations evaluated versus AMP
- It confirms the previous results with another formulation

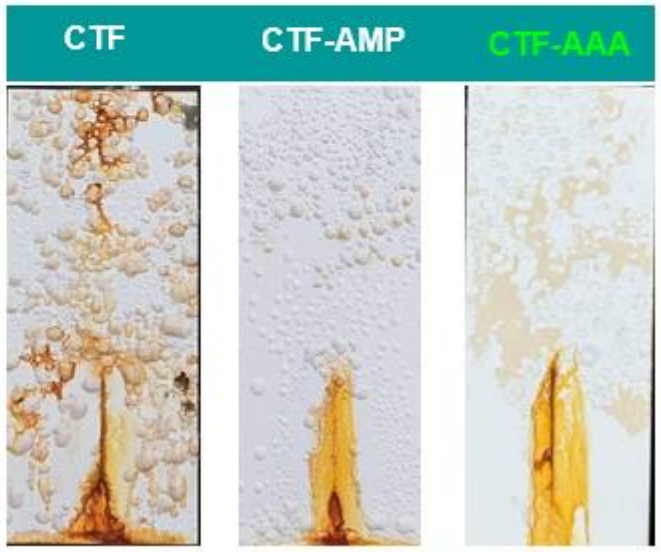
Wet Adhesion and Salt Spray Tests With 4%wt of ACP







ZP: zinc phosphate



CTF: calcium modified silica gel

Test protocol

- ASTM B117-2019 salt spray corrosion testing: 1 week (168 hours, 35°C)
- 5% by weight of analytical grade NaCl in 95% by weight of Type IV water
- pH of collected salt solution: 7.03 ~ 7.16
- 3 mil dry film thickness on steel panels w/ vertical scribe
- Incline 15° - 20° from vertical in slotted holder.

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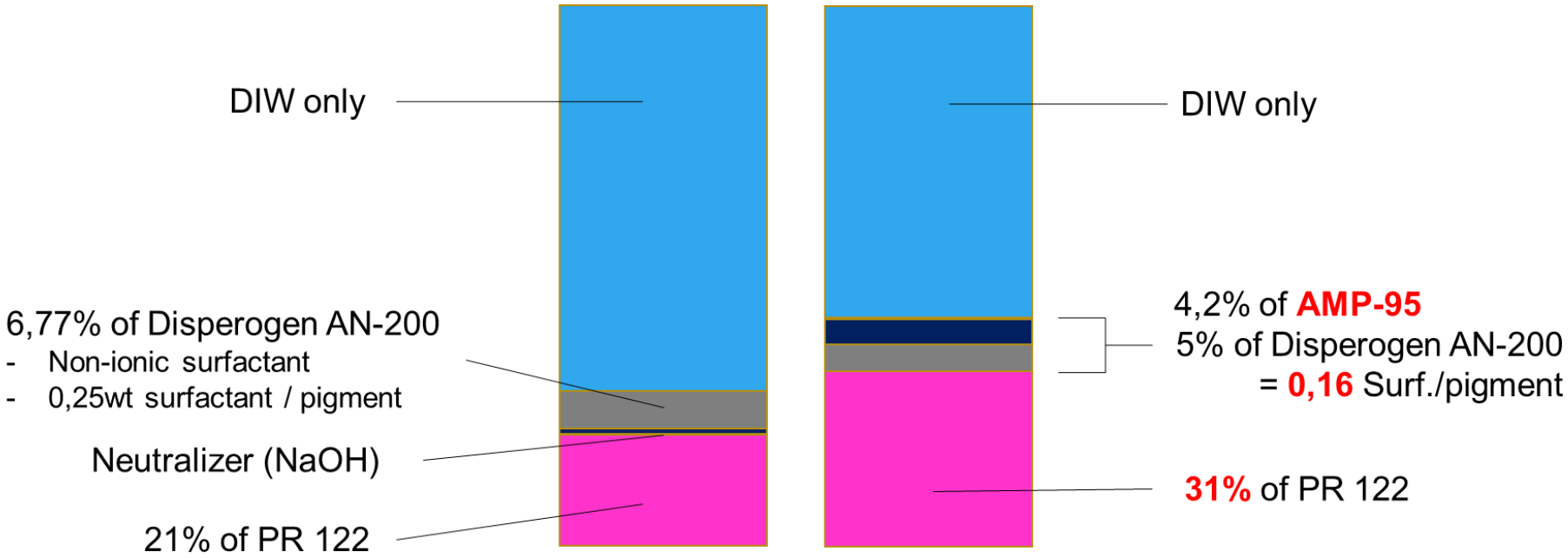
Performance Evaluation of AminoAmyl Alcohol With Organic Pigments

Formulation Selection



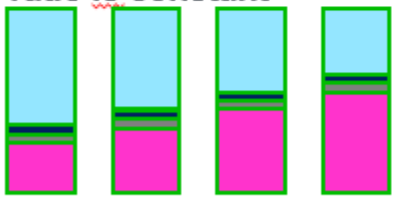
Formulation in water only
50% replacement of conventional dispersing agent with AMP
Side-by-side comparison with the same viscosity
=> Optimization of the solid content

Optimizing the Waterborne Dispersion

Organic pigment grinding

4 **%Solid Content** during grinding

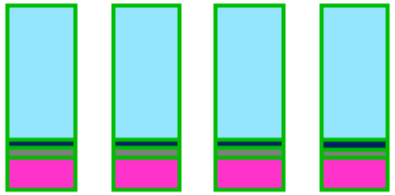
Pigment / dispersant ratio is constant



- High viscosity does not allow experimental evaluations

Dilution of the waterborne dispersion

All formulations at the same % solid content



- Particle size distribution
- Viscosity

Commercial paint tinting

Tinting of 3 commercial white paints with the **same %wt** of PR 122

- Colorimetric tests

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Illustration of the Protocol

PR122 Grinding Optimization With Aminoamylalcohol

	Grinding Step							
Pigment PR122	40,00	50,00	55,00	60,00	40,00	50,00	55,00	60,00
Dispersogen AN 200	16,00	20,00	22,00	24,00	8,00	10,00	11,00	12,00
AAA-96	0,00	0,00	0,00	0,00	6,74	8,42	9,26	10,11
Neutralizer (solution 25%)	11,5	14,4	15,8	14,4	-	-	-	-
Agitan DF 6681	*0,30*	*0,30*	*0,30*	*0,30*	*0,30*	*0,30*	*0,30*	*0,30*
Water	*32,21*	*15,34*	*0,90*	*1,34*	*44,96*	*31,28*	*24,44*	*17,59*
Total	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*
								
Grinding temperature (°C)	55,9	71,1	40,4	64,4	34,3	62,1	59,5	42,3
Visual aspect	Liquid	Cake	Solid	Solid	Liquid	Cake	Solid	Solid
	Dilution at 15%							
Viscosity (cP)	310	330	292,5	-	165	150	127,5	142,5
Particle size (nm)	320	300,0	260	-	290	190	160	150
Tinting strengh Paint 1	100	104,2	108,1	-	104,1	105,8	108,0	117,0
Tinting strengh Paint 2	100	104,4	104,2	-	102,0	107,2	111,1	122,9
Tinting strengh Paint 3	100	101,7	105,0	-	113,0	114,9	118,2	127,3
Average	100	103,4	105,8	-	106,3	109,3	112,4	122,4

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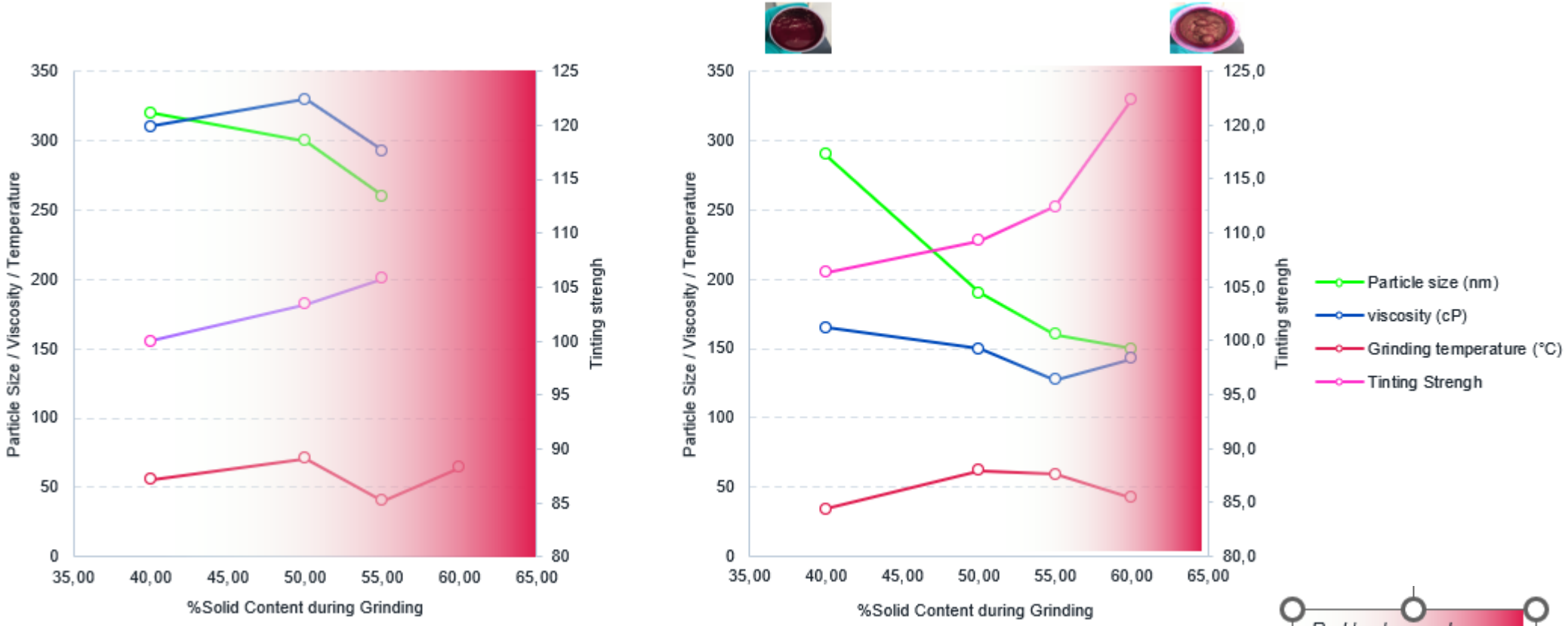
Evolution of Results With %SC During Grinding

Example With PR122 and AAA™ Versus Reference

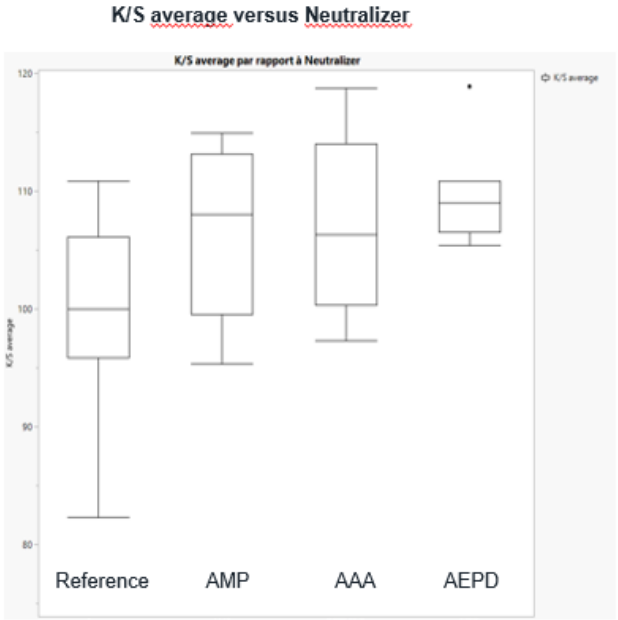


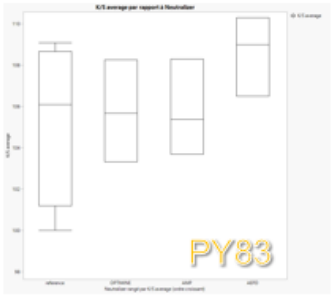
- By increasing the solid content, grinding is more effective
- Optimization of particle size improves tinting strength

Red background corresponds to the domain of SC where the paste is still solid after grinding

Comparison of 3 Pigments

PV23 PR122 PY83





Tinting Strength

Addition of 7%wt of the WB pigment paste to 3 commercial paints (Envie! Satin, Zolpan Inter Acryl Mat, Zolpan Inter Acryl Satin)

AAA, AMP and AEPD improve the tinting strength of the 3 commercial white paints evaluated

AEPD is a better option for organic pigment dispersion

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Compatability of AAA With Registered Biocides

Biostability Evaluation Protocol

Inoculum concentration in the sample:

- Bacteria ≈ 105 to 107 CFU/g or /ml of sample
- Yeast and mold ≈ 103 to 105 CFU/g or /ml of sample

To assess contamination following each inoculation, samples are surface-plated on tryptic soy agar for bacterial counts and on malt extract + chloramphenicol agar, selective medium for yeast and mold counts.

After an incubation period of 5 to 7 days, microbial counts are expressed in “colony forming units” per gram or per milliliter of product (CFU/g or CFU/ml).

This test method allows the detection of microbial contamination as low as 10 CFU/g or 10 CFU/ml (detection limit). A contamination lower than 10 CFU/g or /ml cannot be detected.

Microorganism	Reference
Bacteria	
Alcaligenes faecalis	DSM 30030
Burkholderia cepacia	DSM 7288
Klebsiella aerogenes	DSM 30053
Proteus hauseri	DSM 30118
Pseudomonas aeruginosa	DSM 939
Pseudomonas fluorescens	DSM 50090
Pseudomonas putida	DSM 291
Yeast	
Yarrowia lipolytica	DSM 8218
Saccharomyces cerevisiae	DSM 70449
Mould	
Aspergillus brasiliensis	DSM 1988
Penicillium ludwigii	DSM 1945

- **Decorative paint formulations were prepared containing either BIT or CMIT / MIT as the preservative and loaded at 4 concentrations:**

  50ppm < [BIT] < 300ppm

  6ppm < [CMIT / MIT] < 20ppm

- **Sterility of the paint and biocide concentration is checked before starting the microbiologic challenge test**
- **6 bacteria / yeast / mold innoculations are carried out as described on the left**

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Overview of Compatibility with Registered Biocides

Biocide	Concentrations	AA	w#1	w#2	w#3	w#4	w#5	w#6
CMIT/MIT	6	NaOH	1	0	0	1	2	3
	15		0	0	0	0	0	3
BIT	50		0	1	3	3	3	3
	200		0	0	1	2	3	3
CMIT/MIT	6	AMP	1	0	0	0	0	0
	10		1	0	1	0	2	0
	15		0	0	0	1	0	0
	20		0	0	0	1	0	1
BIT	50		0	0	0	0	1	0
	100		0	0	0	0	0	1
	200		0	0	2	0	0	0
	300		0	0	0	0	0	0
CMIT/MIT	6	AAA	0	0	0	0	0	0
	10		0	0	0	0	1	0
	15		0	0	0	0	2	0
	20		0	0	1	0	0	1
BIT	50		1	0	0	0	1	1
	100		0	0	0	0	0	1
	200		1	0	0	0	0	0
	300		0	0	0	0	0	0

Colour code, score and level of contamination:

3	≥ 1000 CFU/g or /ml	**Inefficient** protection against microbial contamination
2	100 - 999 CFU/g or /ml	**Moderate** protection against microbial contamination
1 0	10 - 99 CFU/g or /ml No microbial recovery (<10)	**Efficient** protection against microbial contamination

- **All Advancion alkanolamines supporting the effectiveness of the registered biocide, it is not the case with caustic**

At the same molar concentration:

- **AAA performance is equivalent to AMP**

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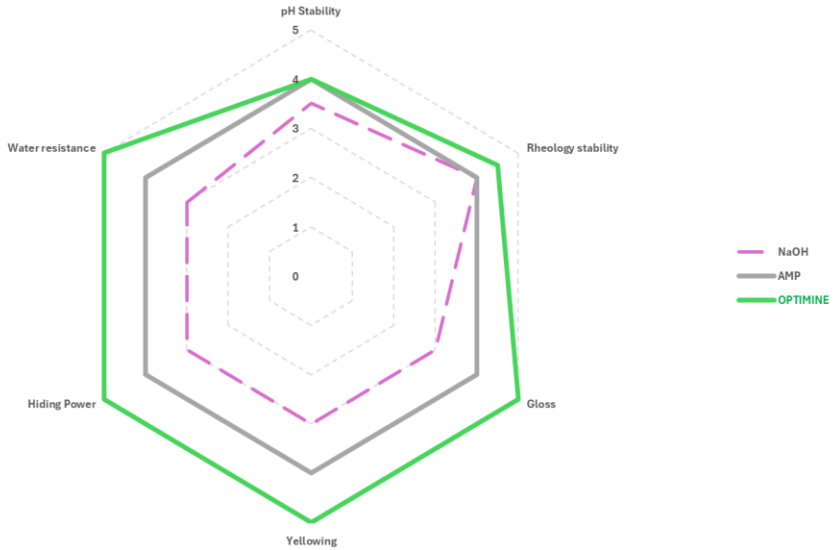
In Closing

- Aminoamyl alcohol provides **enhanced overall performance compared to AMP**
- Aminoamyl alcohol provides **improved pigment dispersion and gloss performance** in both deco and industrial formulations
- **Equivalent molar dosage (neutralization efficiency) in formulation** between Aminoamyl alcohol and AMP
- Aminoamyl alcohol can help formulators and manufacturers further **optimize the overall cost and performance of their formulations**



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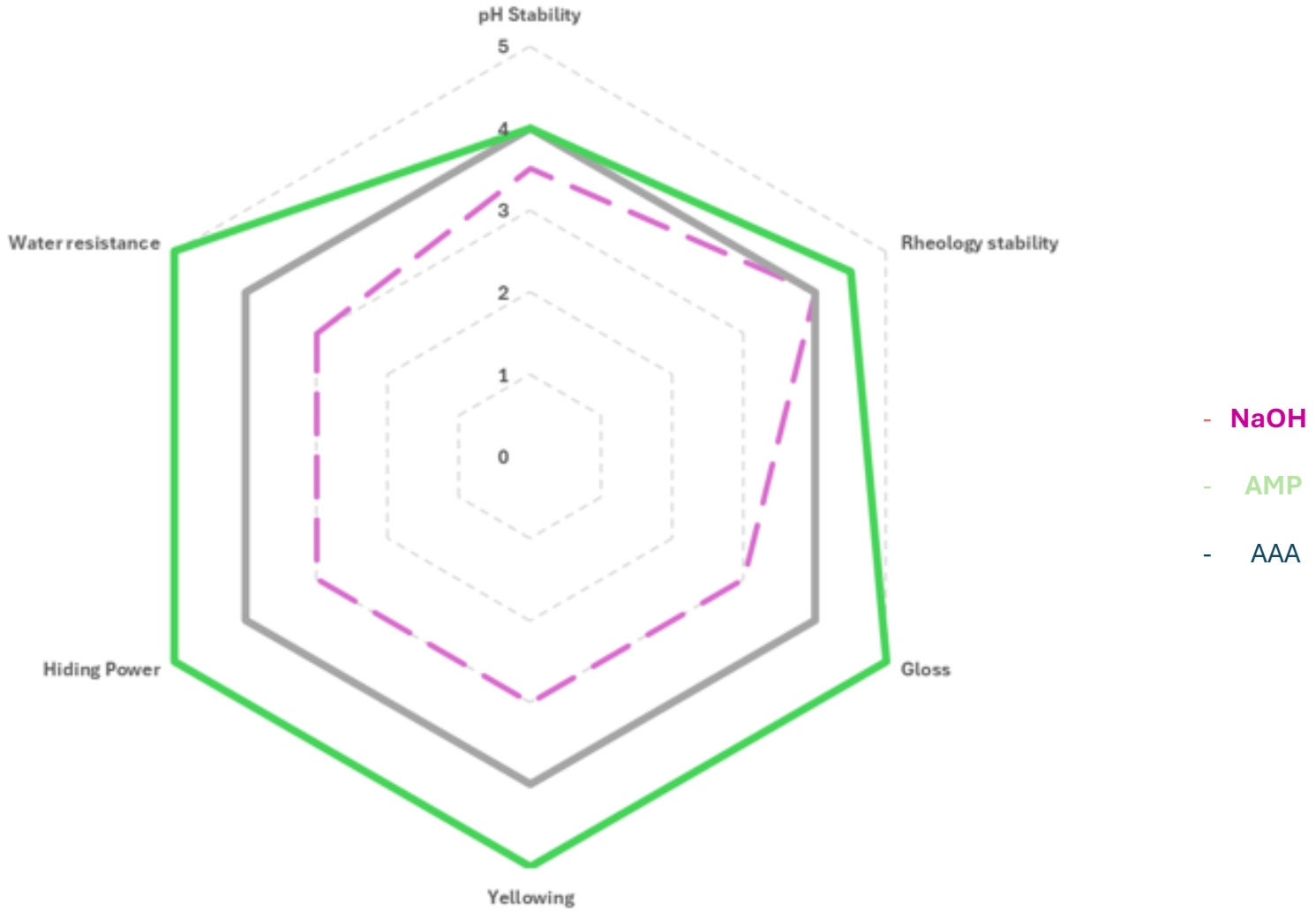
A New Standard for Multifunctional Performance

Aminoamyl alcohol versus AMP in architectural decorative paint



A New Standard for Multifunctional Performance

Aminoamyl alcohol versus AMP in architectural decorative paint