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Spread

PVA Innovations Hit Low-VOC SWEET SPOT for Contractors

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Paint purchasing decisions for commercial and institutional architecture are influenced by many cooks in the kitchen, from architects and designers to building owners, building managers and more. In addition to dictating color and sheen, these stakeholders are specifying low- and ultra-low VOC coatings in order to gain various green building credits as well as building certifications. In a 2015 survey of commercial paint contractors commissioned by the Paint Quality Institute (PQI), 90% of respondents said specification plays an extremely important, very important, or moderately important role in paint selection. The survey further revealed that the commercial paint contractor's biggest application challenges involve overcoming problems relating to paint coverage. Top complaints included inconsistent coverage,

TABLE 1—Typical Physical Properties of Multi-Purpose Vinyl Acrylic Emulsion[a]

PROPERTY	TYPICAL VALUES
CHEMISTRY	VINYL ACRYLIC
SOLIDS (WT%)	~55%
PH	4.5-6.0
VISCOSITY (CP #2, @60 RPM, 25°C)	500 MAX
MFFT (°C)	<5
COALESCENT DEMAND (%BPOS)	2%

(a) May require up to 2% coalescent in some formulation spaces.

PVA Innovations Hit Low-VOC **Sweet Spot** for Contractors

insufficient hiding, and the need for multiple coats.

To help paint formulators satisfy multiple stakeholder needs in the commercial contracting space, two complementary technologies for broad wall application of contractor grade paint have been developed. One is a solvent-free[1]-capable, APEO-free[2] vinyl acrylic emulsion with flat through semi-gloss formulation latitude across a broad PVC range. The other is an amine-based, solvent-free, APEO-free HEUR rheology modifier that offers excellent sag-flow balance, higher film build, and improved surface smoothness. These technologies may be used alone or in combination with other rheology modifier chemistries to meet ultra-low VOC specifications across a range of commercial contractor needs, from economy paints for new construction to more durable paints for institutional maintenance. Research also demonstrates that the amine-based HEUR offers notable improvements in applied hiding and more consistent coverage across multiple application methods, including brush, roller, and spray.

More Specification, Less VOC

In 2015, the Paint Quality Institute (PQI) commissioned a survey through global market research firm TNS to better understand the unmet needs and formulator opportunities in the commercial contractor segment, finding it accounts for approximately 25% of the U.S. architectural paint market. Typical projects span a variety of non-residential buildings, from schools and shopping centers to hotels and hospitals. Unlike the residential paint contractor who largely owns the purchasing decision, this study reveals that the purchasing decision in the commercial contractor segment is shared among all stakeholders in a given project: the painter controls the brand and type decision, the designer and architect control the sheen, and the architect drives the need for specification. When broken down by project type, the research found that paint specification is more prevalent and far more prescriptive for the commercial contractor doing at least 25% of his/her work in new construction. The survey also found that specification is dramatically more prevalent for institutions such as schools and hospitals versus commercial venues such as office buildings, shopping centers, and hotels. LEED was the most commonly cited specifying guideline, followed by UL for repaint projects, and MPI for new construction.

For the paint formulator, these market insights highlight the increasing complexity involved in serving the commercial contractor space. While the PQI/TNS survey results underscore the growing need for low- and ultra-low VOC offerings in this space, they also demonstrate that offerings must satisfy multiple stakeholders and deliver variable price points and paint properties

TABLE 2—Formulation Details for Test Paint Containing Multi-Purpose Solvent-Free Binder and Evaluated per MPI Specification 144 (Velvet-like)

MATERIAL NAME	POUNDS
GRIND	
WATER	250.0
TAMOL™ 1124	6.2
TERGITOL™ 15-S-9	1.9
FOAMSTAR ST-2438	2.0
KATHON LX 1.5%	1.7
NATROSOL PLUS 330	2.5
TI-PURE R-706	225.0
POLYGLOSS 90	65.0
MINEX 4	80.0
MINEX 7	40.0
GRIND SUB-TOTAL	674.3
LETDOWN	
WATER	50.0
ROVACE™ 10	325.0
FOAMSTAR ST-2438	2.0
OPTIFILM 400	3.6
AMP-75	1.5
ACRYSOL™ RM-6000	12.9
ACRYSOL™ RM-725	14.9
WATER	55.8
TOTALS =>	1140.0
PVC:	45.0%
VOLUME SOLIDS:	34.0%

TABLE 3—Formulation Details for Test Paint Containing Multi-Purpose Solvent-Free Binder and Evaluated per MPI Specification 143 (Flat)

MATERIAL NAME	POUNDS
GRIND	
WATER	167.0
TAMOL™ 1124	5.0
TERGITOL™ 15-S-9	1.9
KATHON LX 1.5%	1.7
DEEFO 1015	1.8
TI-PURE R-706	200.0
MINEX 4	70.0
OPTIWHITE MX	130.0
DIAFIL 525	30.0
ATTAGEL 50	1.5
GRIND SUB-TOTAL	607.2
LETDOWN	
ROVACE™ 10	367.0
ROPAQUE™ ULTRA EF	51.0
DEEFO 1015	1.8
OPTIFILM 400	4.8
AMP-75	5.1
ACRYSOL™ RM-7	3.0
ACRYSOL™ DR-180	10.0
WATER	94.5
TOTALS =>	1144.4
PVC:	50.0%
VOLUME SOLIDS:	42.0%

as dictated by project type. With these factors in mind, Dow Coating Materials has developed a multi-purpose vinyl acrylic emulsion that offers solvent-free[1] and APEO-free[2] formulation capability for flat through semigloss sheens across a broad PVC range (see *Table 1* for typical physical properties). The versatile binder may be used to formulate new construction, premium and mid-tone flats, as well as quality satins and semigloss blends. As outlined in *Tables 2* and *3,* and demonstrated in *Table 4,* this multi-purpose binder can be formulated into flat and velvet-like sheen paints that meet stringent specifications such as those outlined by MPI.

More Application Options, Less Color Variation

To demonstrate the broad PVC range of the solvent-free capable, multiple-purpose vinyl acrylic emulsion, test paints were formulated across a PVC range of 20–80 in increments of 15 PVC based on the starting point details outlined in *Table 5*. To evaluate color acceptance as affected by PVC, a colorant blend was added to each test paint at a rate of 4 oz per 100 gal of paint. Drawdowns were created with a 3 mil bird applicator and dried overnight at constant room temperature (72°F/24°C) and 50% relative humidity prior to a second application with a brush. As detailed in *Table 6,* the multi-purpose vinyl acrylic emulsion demonstrated quality color acceptance across a broad PVC range over both sealed and unsealed chart sections. In the contractor-applied market, color acceptance is a particularly important paint property: contractors want to avoid the appearance of color variations

TABLE 4—Results from Internal Testing Demonstrate Ability of Multi-Purpose, Solvent-Free Vinyl Acrylic Binder to Be Formulated to Meet Multiple MPI Specifications

	MPI #143 SPECIFICATIONS	TEST PAINT PERFORMANCE	MPI #144 SPECIFICATIONS	TEST PAINT PERFORMANCE
DESCRIPTION	LATEX, INTERIOR, HIGH PERFORMANCE	—	LATEX, INTERIOR, INSTITUTIONAL, LOW ODOR/LOW VOC "VELVET LIKE"	—
GLOSS LEVEL	1	—	2	—
MAX VOC	10	NEAR 0	10	NEAR 0
MAX 60° GLOSS	5	3	10	10
MAX 85° GLOSS	10	4	35	15
HIDING POWER	≥98%	99%	≥98%	98.1%
REFLECTANCE	≥92%	97%	≥92%	99%
SCRUBBABILITY	1000 CYCLES, SLIGHT DIFFERENCE IN GLOSS (VISUAL)	PASS	3000 CYCLES, <25% CHANGE IN 85° GLOSS	PRESS
BURNISH	NA	—	<3 UNIT CHANGE IN 85° GLOSS	+1 CHANGE
CLEANSABILITY	NA	—	COFFEE 2.0Δe NIGROSIN 1.0Δe GRAPHITE 1.5Δe	TESTING IN PROGRESS
ALKALI	NO SIGNS OF LIFTING, WRINKLING, DISINTEGRATION, SLIGHT COLOR CHANGE	PASS	NO SIGNS OF LIFTING, WRINKLING, DISINTEGRATION, SLIGHT COLOR CHANGE	PASS
FLEXIBILITY	FILM INTACT	PASS	FILM INTACT	PASS

TABLE 5—Starting Point Formulation Details—Vinyl Acrylic Flat

MATERIAL NAME	POUNDS
GRIND	
WATER	100.0
CELLOSIZE™ QP-4400 HEC (2.5 %SOL'N)	100.0
AMP™-95 NEUTRALIZER	0.8
TAMOL™ 1124 DISPERSANT	8.0
TERGITOL™ 15-S-9 SURFACTANT	2.0
TEGO FOAMEX 1488 DEFOAMER	3.0
TITANIUM DIOXIDE[a]	200.0
OMYACARB 8 EXTENDER	47.7
MINEX 4 EXTENDER	49.2
DIAFIL 525 FLATTENING AGENT	30.0
SATINTONE W EXTENDER	73.8
GRIND SUB-TOTAL	614.5
LETDOWN	
ROVACE™ 10 VINYL ACRYLIC EMULSION (55% TS)	305.9
COALESCENT/PLASTICIZER	0.0
ROPAQUE™ ULTRA OPAQUE POLYMER	35.0
TEGO FOAMEX 1488 DEFOAMER	1.0
CELLOSIZE™ QP-4400 HEC (2.5% SOLN'N)	114.8
ACRYSOL™ RM-6000 RHEOLOGY MODIFIER	10.2
WATER	50.0
TOTALS =>	1131.4

FORMULATION CONSTANTS	
PVC (%)	50%
VS (%)	35%
TOTAL COALESCENT	0%
VOC (g/L)	2.6

(a) Ti-Pure R-706, DuPont.

after touch ups, as these can lead to customer complaints and callbacks. As demonstrated by the 50 PVC test paint photo in *Figure 1,* the multi-purpose, solvent-free vinyl acrylic emulsion exhibits excellent color acceptance and white hiding pigment dispersion, with no visible variation between the initial drawdown and the subsequent brush-up.

More Coverage, Fewer Coats

In addition to meeting third-party paint specifications, the PQI/TNS survey of commercial contractors found that paint selection is highly influenced by the contractor's past experience. Professionals in this space have historically preferred paints that cover in the fewest number of coats, as well as paints that minimize brush and roller marks and offer excellent touch-up of surface imperfections. While many gains have been made in performance properties like durability and scrub resistance, the 2015 PQI/TNS survey reveals that there continues to be room for improvement in these application attributes. Sixty-three percent of survey respondents said that having to apply multiple coats is a frequent problem; 47% cited problems stemming from paint not covering as much as they thought it would; and 37% cited problems arising from seeing the original color through the new paint.

Efforts to address unmet application needs in the commercial contractor space have largely stumbled due to the formulation balancing process, which often leads to compromises in pigment and dispersant chemistry choices and limits the use of synthetic rheology modifiers that would allow for a smooth, uniformly distributed coating when applied. To help paint manufacturers improve the application performance of commercial contractor coatings while maintaining a desired balance between formulation cost and performance, a solvent-free, surfactant-free, amine-based HEUR has been developed that offers excellent KU efficiency in PVA paint formulations. (See *Table 7* for typical physical properties.) Unlike conventional HEURS in

TABLE 6—Test Paints Formulated with Multi-Purpose Acrylic Emulsion and Tinted with Colorant Blend (125 g of 808 Lamp Black, 250 g of 808 Yellow Oxide, 75 g of 808 Brown Oxide) Demonstrate Color Acceptance Across a Broad PVC Range

PVC	ΔE SEALED	ΔE UNSEALED
20	0.72	0.68
35	0.39	0.41
50	0.18	0.20
65	0.25	0.20
80	0.37	0.38

FIGURE 1—Comparison of drawdown and next-day brush-up of ultra-low VOC 50 PVC flat formulated with multi-purpose acrylic emulsion and tinted with 4 oz/100 gal colorant blend (125 g of 808 lamp black, 250 g of 808 yellow oxide, 75 g of 808 brown oxide) demonstrates excellent touch-up properties.

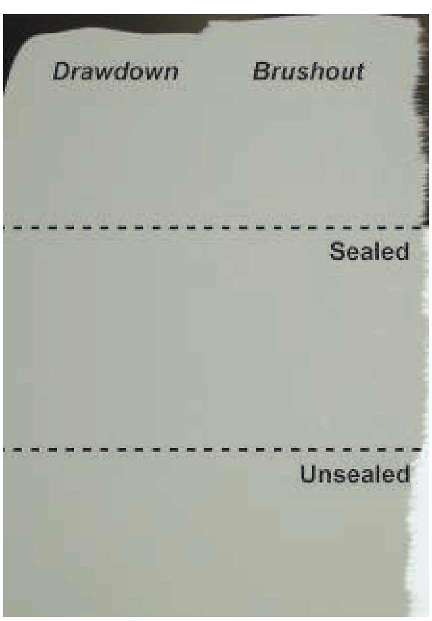


TABLE 7—Typical Physical Properties of Solvent-Free Amine-Based HEUR Rheology Modifier

PROPERTY	TYPICAL VALUES
APPEARANCE	HAZY LIQUID
pH	~3.0
SOLIDS, %	18.0
ACTIVE POLYMER, %	15.0
SOLVENT	WATER
BROOKFIELD VISCOSITY, cP	< 3500
DENSITY, LB/GAL	8.65

FIGURE 2—Next-generation HEUR technology replaces solvent and surfactant with pH-triggered thickening.

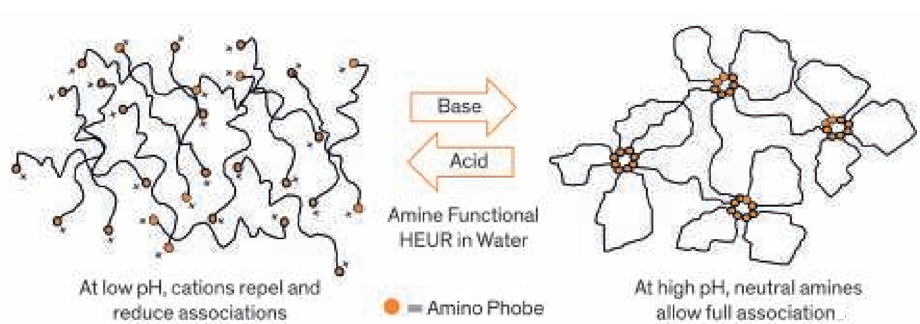


FIGURE 3—Solvent-free amine-based HEUR offers ultra-low VOC contribution in PVA pastel base (41% PVC; 38% VS) and better sag-leveling balance vs a conventional HEUR and a commercially available nonionic synthetic associative thickener.

KU BUILDER	KU VISCOSITY	ICI VISCOSITY	SAG RESISTANCE	LENETA LEVELING
HEUR 1	100	2.0	6 DRIP	10
AMINE HEUR	108	1.5	16	10
NSAT	96	1.4	8 DRIP	10

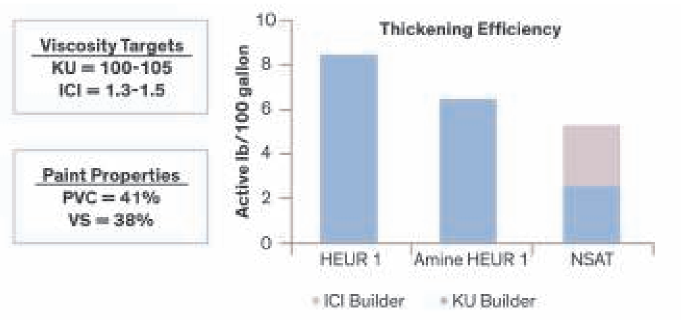
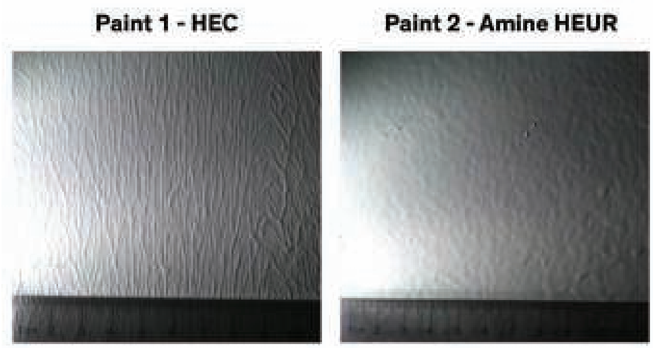


FIGURE 4—PVA test paint formulated with next-generation amine-based HEUR demonstrates notable improved pattern uniformity and surface smoothness vs HEC.



500-525 ft^2/gal coverage rate

the low-VOC space, this next-generation technology achieves low as supplied viscosity during paint manufacturing without the addition of surfactant, which can raise formulation cost and complexity. As illustrated in *Figure 2,* it employs a proprietary pH-triggered system that turns thickening off during paint making for easy pumping and mixing, then turns it on after paint making for full thickening efficiency as needed during paint application.

More Flow, Less Sag, Better Hiding

This next-generation HEUR technology is also differentiated from conventional HEUR thickeners in its ability to overcome limitations related to sag resistance and flow. Optimizing sag resistance without sacrificing flow has been an ongoing rheology challenge: increasing Brookfield viscosity to deliver desired sag resistance reduces flow, while decreasing Brookfield viscosity to improve flow reduces sag resistance. The next-generation HEUR technology offers a rheology first: as demonstrated in *Figure 3,* this rheology breakthrough notably increases sag resistance while maintaining excellent flow. As shown in *Figure 4,* a comparison of roller applied PVA paint demonstrates greater pattern uniformity and visibly improved surface smoothness resulting from the next-generation HEUR versus HEC. As reported in *CoatingsTech,* March 2014,[3] enhancing pattern uniformity and surface smoothness facilitates improvements in applied hiding.

SUMMARY

In the commercial paint contractor space, the recipe for success increasingly calls for multiple ingredients, including ultra-low VOC specification for architects, enhanced coverage and hiding for applicators, utility across a range of paint quality points, and an optimal performance versus cost balance for formulators. A solvent-free capable, multi-purpose vinyl acrylic emulsion can be formulated to meet various MPI specifications while offering formulation flexibility across a broad PVA range. In addition, a recently developed solvent-free, amine-based HEUR rheology modifier may be used to enhance the application performance of PVA- and VAE-based contractor paints without forcing the formulator to compromise on surface coverage, smoothness, or touch-up performance in order to achieve the desired balance between performance and cost. Maximizing film uniformity and touch-up allows for improved applied hiding, and minimizes the application pattern difference between edging with a brush and roller or spray application of the broad wall. Together, these technologies can help to ensure consistent application performance for contractors, improved surface smoothness for consumers, and low VOC for regulators. ❊

ENDNOTES

1. Manufactured without solvent; use low-VOC coalescents for solvent-free formulations.
2. Manufactured without APEO surfactants.

3. Rabasco, J.J., Conley, T.L., Fasano, D., and Saucy, D., "Next Generation Rheology Modifier Technology: Novel Molecular Architecture for Breakthrough Sag/Flow Balance, Universal Viscosity Retention on Tinting, and Optimum Applied Hide," *CoatingsTech*, 11 (3) 58 (2014).

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