Eastman OPTIFILM™
enhancers

Making zero VOC and low-emission formulating easy

Now every paint color you formulate can be a little greener.

Ever-changing environmental regulations and everyday consumer demands are challenging paint formulators to develop quality low-emission, zero-VOC solutions.

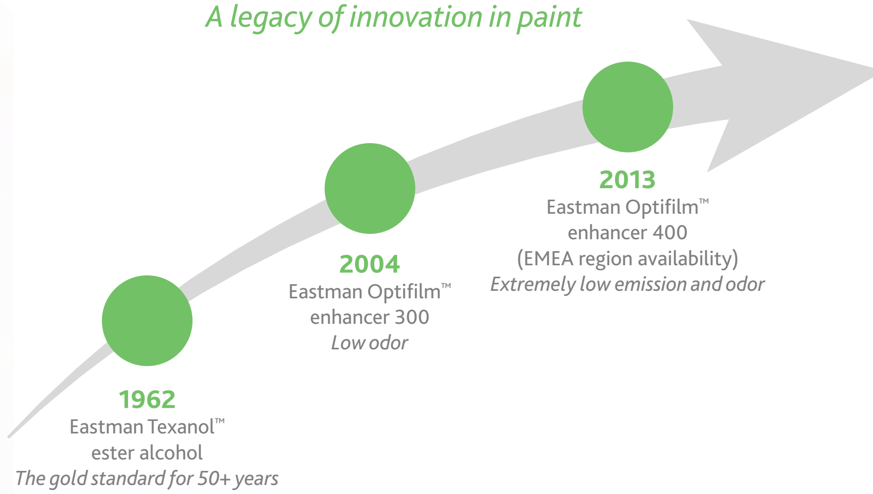
Eastman Optifilm™ enhancer 400 is a coalescent with extremely low emissions and low odor that makes reformulating easy.

Before the introduction of Optifilm 400, paint manufacturers often had to completely reengineer existing formulations using coalescent-free polymers—a drastic step. Reformulating is time and resource intensive and often leads to higher formulation costs. New formulations often require extensive lab work to qualify new raw materials and calculate adjustments to the color palette to meet paint specifications. Optifilm 400 allows formulators the opportunity to continue to use high T_g resin systems and meet any new emission regulations with minimum hassle.

In other words, no emissions . . . and no compromises. Optifilm 400 delivers a fast solution with superior performance for interior wall paint with lower emissions.

Eastman's VOC-compliant coalescing aid portfolio

A legacy of innovation in paint



Emission data

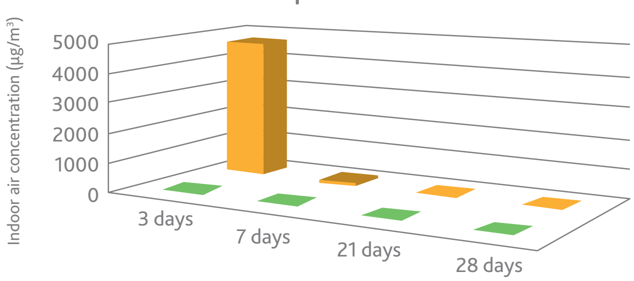
Using a microchamber and following ISO-16000 guidelines, emissions from laboratory-formulated matt and silk paints containing a conventional coalescent and Eastman Optifilm™ enhancer 400 were collected after 3, 7, 21, and 28 days. The silk paints were prepared using approximately 1.4% w/w coalescent and the matt paints with approximately 0.5% w/w coalescent. The emissions were determined under the industry standard ambient conditions (23°C) and at an elevated temperature (40°C) to provide extra information on emissions in hot climates.

Results were calculated as µg/m³ (room concentration). It is important to note that using toluene equivalents to calculate the TVOC (total volatile organic compounds) will give an indication of the emission values; but it can also be very misleading for several reasons. First, the TVOC can include emissions from many paint constituents other than the coalescent, such as propylene glycol and mineral oils. Second, the detector response of the constituents may be very different to toluene thus leading to under or over estimation of their relative concentrations. To get a true value for coalescent emission alone, it is important to quantify it individually using a calibration based on the actual substance.

Unlike conventional coalescents, Optifilm 400 remains in the paint film. Therefore, even at elevated temperatures, the emissions of Optifilm 400 from a paint film are negligible.

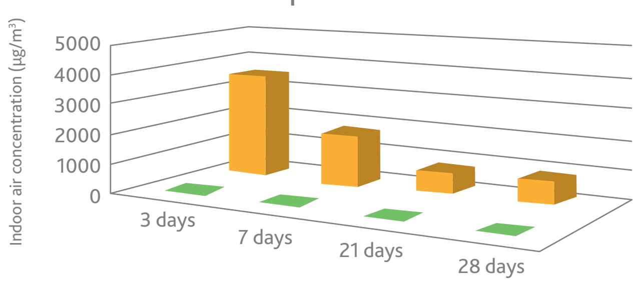
Further emission data is available on request.

Matt paint 23°C



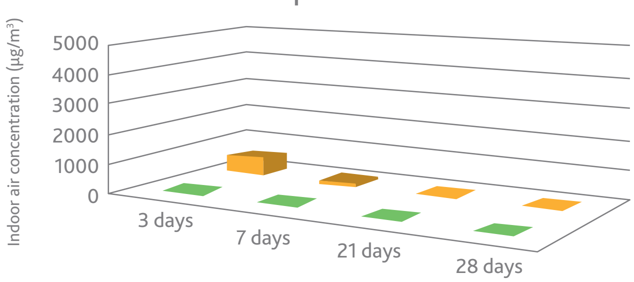
	3	7	21	28
Optifilm 400	2	2	2	2
Conventional coalescent	4711	88	0	0

Silk paint 23°C



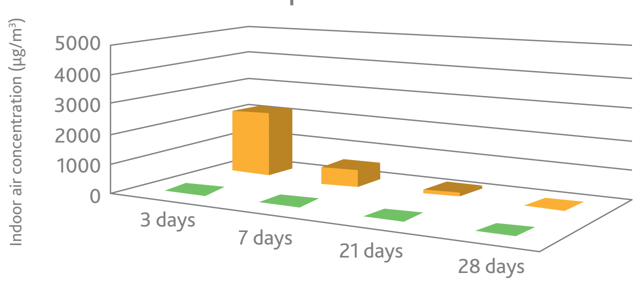
	3	7	21	28
Optifilm 400	2	2	2	2
Conventional coalescent	3810	1931	791	835

Matt paint 40°C



	3	7	21	28
Optifilm 400	0	0	0	0
Conventional coalescent	620	108	29	0

Silk paint 40°C



	3	7	21	28
Optifilm 400	0	0	0	0
Conventional coalescent	2271	556	150	57

Final paint film performance

The binder has a significant impact on the performance of the final paint film. As such, changing the binder can often drastically affect the overall paint film properties. To rectify any changes this may have on the final paint film, formulators have to spend a significant amount of resource and additional raw material costs on the extensive reformulation that is often required when switching to coalescent-free polymers.

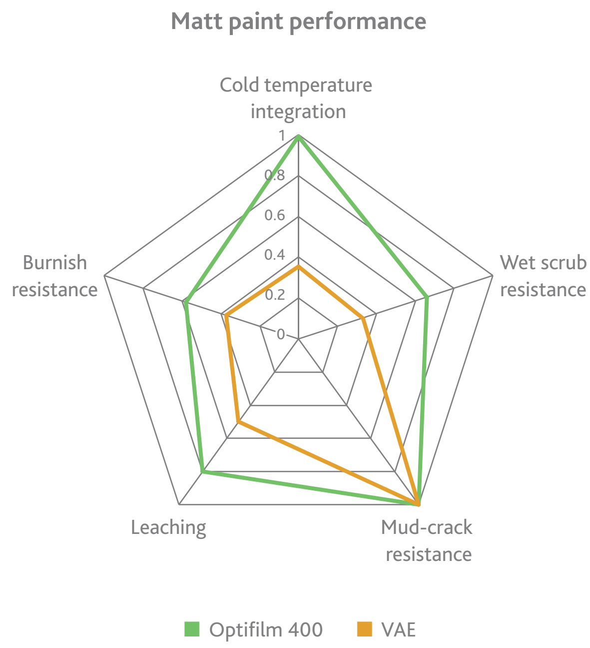
Now, with the introduction of Eastman Optifilm™ enhancer 400, formulators have the option of reformulating their existing products using a drop-in,[1] extremely low-emission, low-odor coalescing aid.

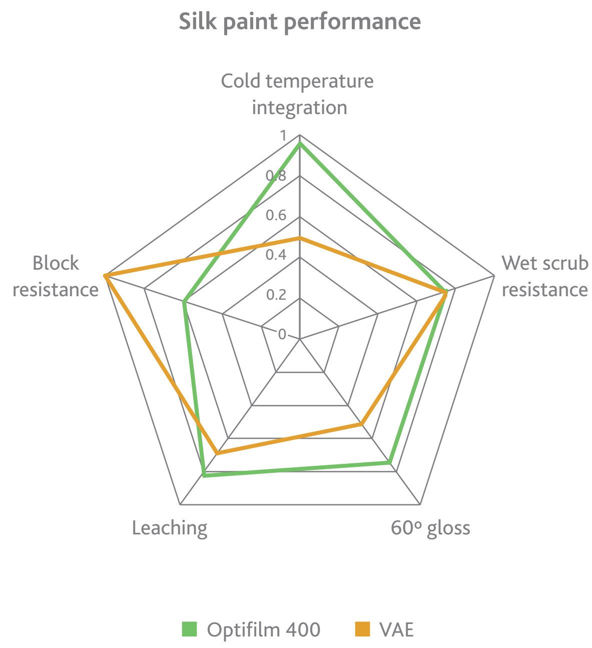
Eastman's European Technical Centre has conducted extensive testing to compare the final paint film properties of a coalescent-free paint formulated with a vinyl acetate ethylene (VAE) resin against a paint formulated with high T_g standard styrene/acrylic resin and Optifilm 400.

The two radar charts show five important performance parameters that need to be considered when (re)formulating matt and silk interior paints. Other key properties (e.g., opacity) did not differ significantly between the two systems and therefore have been omitted from the charts.

The matt test paints formulated with Optifilm 400 gave similar results across the key parameters.

As the earlier emission results clearly demonstrate, unlike conventional coalescents, Optifilm 400 does not leave the paint film. In silk paints this can result in a reduction of the block resistance of the coating because the film may be softened slightly.





[1] *In many experiments conducted at the European Technical Centre, Eastman Optifilm™ enhancer 400 has proven to be more efficient than Eastman™ Texanol ester alcohol, however, every formulation is unique.*

Cold temperature integration

The cold temperature integration (CTI) test determines how well paint can be applied to a previously painted film to correct any surface defects, e.g., scuff marks.

During the drying process, paints are subjected to varying climatic conditions. If one has to repair the paint film at a temperature lower than the temperature during the original paint application, incomplete coalescence of the film might occur, resulting in the development of microcracks. These microcracks may not be detectable with the naked eye but will produce a visible color difference between the originally painted and newly repaired area.

To evaluate the CTI of the test paints, the paint was tinted blue and drawn down at two different temperatures (5°C and 23°C). The color difference was then measured using a spectrophotometer.

A color difference between the first and second coat of the silk VAE-based test paints was clearly visible indicating poor low-temperature film formation.

Formulating low-emission matt and silk paints with Optifilm 400 results in very good film formation under adverse application conditions, giving both the formulators and decorators much more flexibility.

Scrub resistance

The wet scrub resistance of the test paints was evaluated via the BS EN ISO 11998 test method. This method determines the films' integrity by calculating the loss in film thickness after 4 weeks of conditioning.

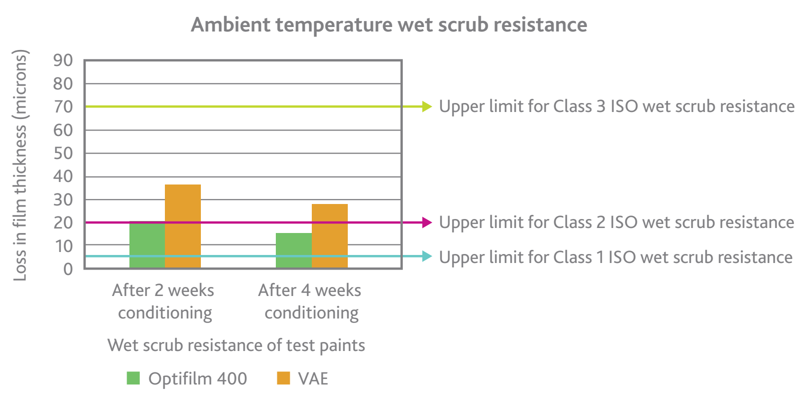
The low-temperature wet scrub resistance of the paints was also evaluated. The paints were applied to Leneta panels and left to dry at 5°C for 48 hours. The panels were then transferred into a temperature-controlled room (23°C), where they were stored at ambient temperature for the remaining conditioning period.

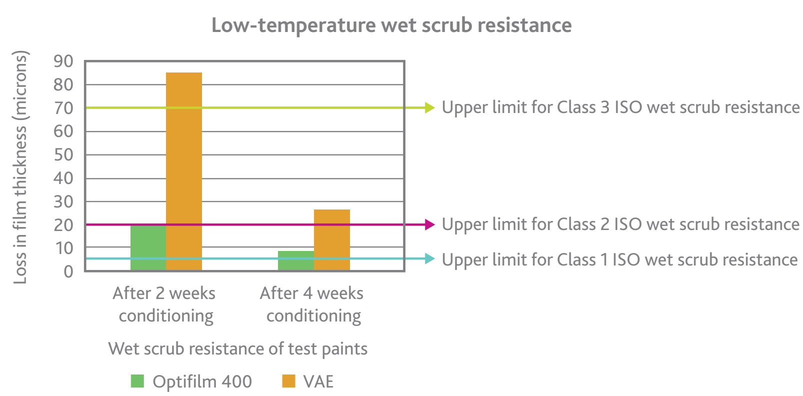
At both ambient and low temperatures, the matt test paints formulated with Optifilm 400 were consistently one DIN class better for wet scrub resistance compared against the VAE-based paint.

To improve the wet scrub resistance of a VAE-based paint, formulators can:

- Reduce the pigment volume concentration (PVC) by increasing the amount of binder thus increasing the overall cost of the formulation
- Change the extender package to include extenders with lower absorption properties to help improve the pigment-binding capacity

Both of these would increase the time and money needed to make the switch to an emission-compliant formulation.





Low-temperature mud cracking (5°C)

Mud cracks are short, irregular cracks that form due to the change in volume during the drying phase. There are a number of factors that can cause mud cracks to appear:

- Poor coalescence at low temperature
- A nonuniform application of paint, resulting in a film that is too thick, usually over a porous substrate
- An unfavorable combination of extenders used, usually with excessively small particle sizes and/or extenders with high oil absorption
- Application over highly absorbent substrates

The following photographs reinforce the complexity of reformulating with a coalescent-free polymer. The VAE-based paint would require a significant amount of time and money to reformulate a number of product ranges. Formulating with Eastman Optifilm™ enhancer 400 offers formulators a drop-in solution, saving both time and money.

Silk Optifilm 400
(200 µm)

Silk coalescent-free VAE
(200 µm)

Low-temperature film formation

The test paints were brush-applied to cement panels at their natural spreading rate, then left to film form at 5°C, 65%–75% R.H.

As the following photographs show, the coalescent-free polymer with a specified MFFT of 4°C does not form a film at 5°C. Accordingly, formulators need to consider the temperature at which the paints will be applied as well as the affect the substrate has on low-temperature film formation. Formulating low-emission paints with Optifilm 400 enables good film formation over a range of climatic conditions and challenging substrates.

Silk VAE paint

Silk paint formulated
with Optifilm 400

Evaluation of leaching of water-soluble materials from latex paint films

For a paint film to remain aesthetically pleasing, latex films need to resist staining caused by the leaching of water-soluble materials. If water comes into contact with a coating during the early stages of drying, there is a risk of staining due to the leaching of surfactants and other water-soluble components from within the film.

A coating's ability to resist staining from water-soluble components within the film is assessed using the ASTM method D7190-10. During the test, paint films are drawn down to give a wet-film thickness (WFT) of 100 µm and left to dry for 4 hours and 4 days under ambient conditions. After the specified time, water droplets are placed on the surface of the film and the films are visually assessed.

These evaluations showed that paints formulated with Optifilm 400 were significantly more resistant to water staining than the coalescent-free paints, even very early in the drying process.

Odor

Although subjective, odor is a key property for many low-emission paints. To evaluate the odor of the test paints, a panel of 8 judges, from 3 different regions, participated in a blind test. The judges ranked the samples on a scale of 1 to 8, with 1 being the least amount of odor. Each paint sample was tested in duplicate.

Odor rating of low-emission coalescents in matt paints after 24 hours

Coalescent sample	China	UK	Asia
Optifilm 400	2.75	4.5	3.5
Coalescent-free polymer (VAE)	4.5	3.75	3.5

In all 3 regions where odor testing was carried out, paints formulated with Eastman Optifilm™ enhancer 400 produced results that indicated very low odor, comparable or even better than the paint formulated with a coalescent-free resin (VAE). There are many other noncoalescent paint constituents that can contribute to the odor of a paint sample; therefore, it is important to ensure that all other components of the final paint film are also low in odor in order to produce truly low-odor paint.

Zero emission. Hero performance.

With Optifilm 400, you can now formulate low-emission, zero-VOC paint with great performance . . . in any market. As various regulatory bodies begin to regulate in can VOCs and introduce emission regulations to control air quality, you can ensure your product performs with:

- Near-zero emission
- Zero VOC
- Excellent film integrity, good touch-up properties, and wet scrub resistance
- Ultralow odor
- Formulation flexibility
- Nonyellowing
- Safe and easy to use

When you choose Eastman as your supplier, there are no compromises. You'll get superior technical support, customer service, and the reliability of a global supply chain.

For more information, visit www.eastman.com/optifilm.

Summary of performance evaluation

		Matt paints		Silk paints	
		Optifilm 400	VAE	Optifilm 400	VAE
Opacity (ASTM D-2805)		●	●	●	●
Gloss 60° (BS EN ISO 2813)		●	◑	●	◑
Cold temp. integration (ASTM D-7489)		●	○	●	○
Colorant acceptance (ASTM D-2244/E-308)	Blue tint	●	●	●	●
	Black tint	●	●	●	●
Mud cracking		●	●	●	●
Low-temperature film formation over cement board		●	●	●●	○
Burnish resistance		●	●	n/a	n/a
Hardness development (day 7)		n/a	n/a	◑	●●
Block resistance (day 7)		●	●	◑	●
Wet scrub resistance (EN ISO 11998)	Room temperature	Class 2	Class 3	Class 1	Class 1
	Low temperature	Class 2	Class 3	Class 1	Class 2
Water resistance		●	●	●	●
Leach test (ASTM D7190-10(2011)		●	○	●	○

● Comparable or slightly improved performance ●● Significant improvement in performance
◑ Reduction in performance ○ Significant decrease in performance

Appendix

Typical physical and chemical properties of Eastman Optifilm™ enhancer 400

Typical properties	Typical value, units
Odor	Ultralow
Specific gravity @ 20°C/20°C	0.967
Solubility in water @ 20°C	0.0 wt%
water in @ 20°C	0.9 wt%
Evaporation rate (*n*-butyl acetate = 1)	0.000017
Refractive index @ 20°C	1.4436
Boiling point @ 760 mmHg	374°C – 381°C
Vapor pressure @ 20°C	<0.0001 mmHg
Freezing point	–50°C
Flash point Pensky-Martens closed cup	199°C (390°F)
Autoignition temperature	385°C
Liquid viscosity @ 20°C	15.8 cP (mPa·s)

Test methods used to evaluate Optifilm 400 against VAE-based interior wall paints

Paint film property	Test method used
Wet scrub resistance	BS EN ISO 11998
Viscosity	ASTM D-562-81 ASTM D-4287 ASTM D2196-10
Cold temperature integration	ASTM D-7489
Low-temperature film formation	In-house test method[a]
Opacity	ASTM D-2805
Gloss	BS EN ISO 2813
Leeching	ASTM D7190-10(2011)
Block resistance	ASTM D4946
Hardness development	BS EN ISO 1522
Water resistance	In-house test method
Colorant acceptance	ASTM D-2244/E-308
Mud-crack resistance	In-house test method
Burnish resistance	In-house test method

[a] *Further details of in-house test methods are available on request.*

Scrub test classification/evaluation of loss of dry film thickness after 4 weeks drying (DIN EN 13 300)

Loss in film thickness	Scrub cycles	Class
<5 µm	200	1
>5 µm and <20 µm	200	2
>20 µm and <70 µm	200	3
<70 µm	40	4
>70 µm	40	5

Optifilm 400 helps you to apply for the following labeling schemes and more.

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Eastman Chemical Company
Corporate Headquarters
P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

U.S.A. and Canada, 800-EASTMAN (800-327-8626)
Other Locations, +(1) 423-229-2000

www.eastman.com/locations

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