

Eastman Optifilm™ additive OT1200:

Low VOC solution for improved open time in water-based trim paints

Introduction

Eastman Optifilm™ additive OT1200 has been designed to enable formulators to produce architectural paints with good open time that can meet the low VOC and emission limits of eco-label compliant coatings.

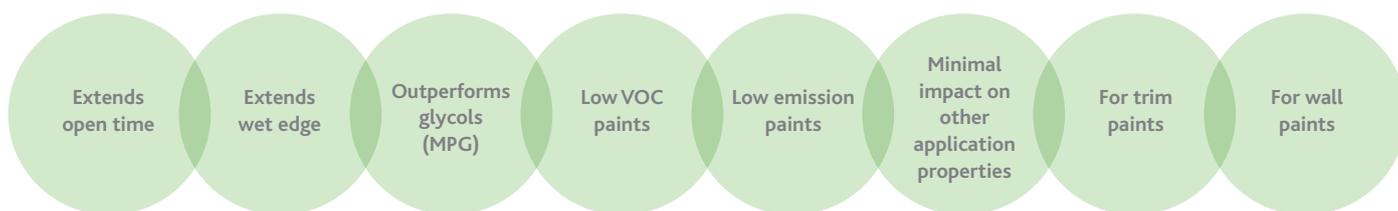
Without compromising paint performance, Eastman Optifilm™ additive OT1200 significantly extends the open time and wet edge of many water-based architectural paint systems. Optifilm™ OT1200 functions in a variety of trim and wall paint systems, including pure acrylic, modified acrylics, self cross-linking, and alkyd emulsions.

It is common to use ethylene or monopropylene glycol (MPG) as open time extenders. However, these glycols have boiling points below 250°C and are consequently volatile organic compounds (VOCs) according to the European Decopaint

Directive (2004/42/EC). Open time and wet edge are often compromised when ethylene or monopropylene glycol (MPG) are removed from a formulation. Eastman Optifilm™ additive OT1200 provides an effective low VOC option to replace MPG. It has also been shown that not only can Optifilm™ OT1200 match the performance of MPG, but it can significantly improve upon it. During Eastman and customer evaluations, there have been many instances where Optifilm™ OT1200 has significantly improved the open time compared with MPG.

Various trim paints were evaluated based on different acrylic polymer chemistries. This technical tip discusses the improvement in open time and wet edge for one of the gloss trim paints evaluated. The effect of open time and wet edge in a semi-gloss formulation when exposed to different humidities and temperatures is also discussed.

Features and benefits of Eastman Optifilm™ additive OT1200



Evaluation of Eastman Optifilm™ additive OT1200 in a white gloss trim formulation

Eastman Optifilm™ additive OT1200 has been fully evaluated in numerous trim and wall paint formulations. In all cases the open time and workability of the paint is improved when compared with MPG. Detailed on the following pages are the application results for a trim paint. These results provide an insight into the extension of open time that can be achieved through the use of this additive.

Formulation details

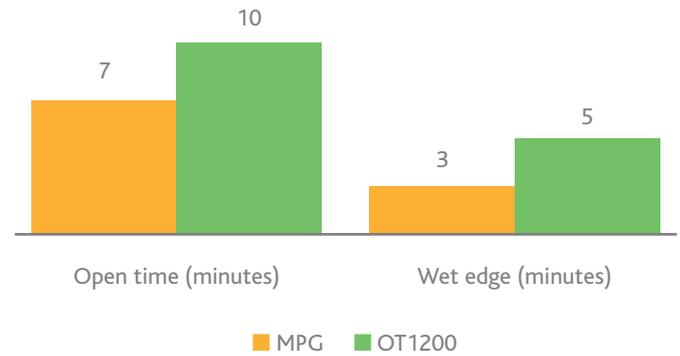
A white, high gloss trim paint was prepared using a pure acrylic binder, Dow Primal™ EP-2596. The paint formulation is thixotropic, which permits high brush loading and non-drip rheology. It is suitable for interior and exterior trim paints. Two formulations were prepared, one based on MPG and the other on Eastman Optifilm™ additive OT1200. These formulations are detailed in Appendix 1.

Open time and wet edge

Open time and wet edge were assessed using a common method as discussed in Appendix 2.

- Compared with MPG, Eastman Optifilm™ additive OT1200 significantly improves the open time and wet edge of the paint.
- Not only can Optifilm™ OT1200 match the performance of MPG, but it can significantly improve upon it.
- A lower level (solids for solids) of Optifilm™ OT1200 was able to outperform a higher level of MPG.

Figure 1. Gloss trim paint: open and wet edge time



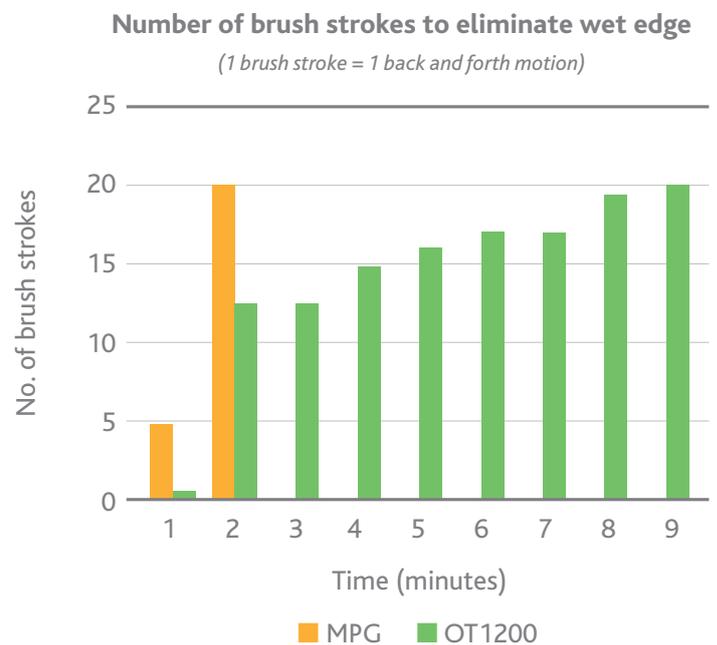
Workability

The improvement in workability achieved in a paint containing Eastman Optifilm™ additive OT1200 as compared to a control with MPG is shown in Appendix 2.

Extending the open time improves the workability of the paint, i.e., it enables the applicator greater time to rejoin painted edges, blend in imperfections such as sags or runs, and reduce viscous drag to enable easier brushing. In order to demonstrate the workability of the paint, the number of brush strokes to eliminate the wet edge and open time lines was recorded. The test was concluded when the paint required greater than 20 brush strokes (1 stroke = 1 back and forth motion) to remove either the wet edge or open time lines.

- With the MPG system, after 2 minutes of drying, 20 individual brush strokes across the edge were required to redissolve or rework the paint edge.
- In the Optifilm™ OT1200 system, it was possible to rework the wet edge up to 8 minutes with fewer brush strokes.

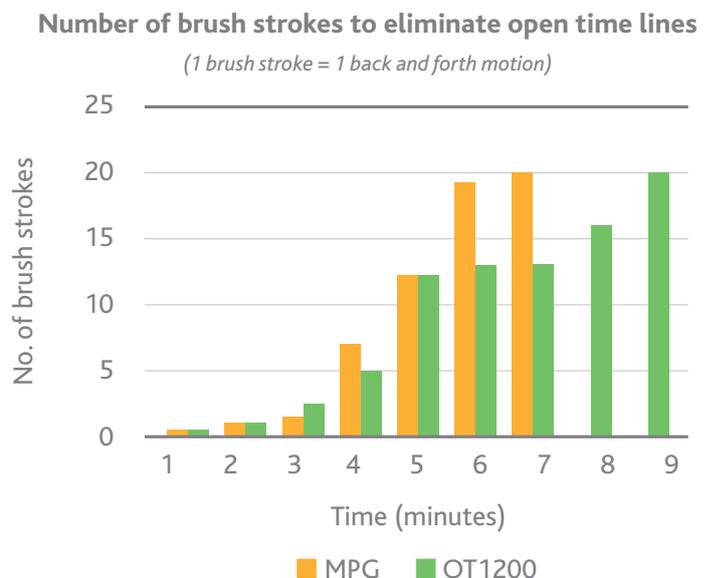
Figure 2. Gloss trim paint: workability of wet edge



Again with the Eastman Optifilm™ additive OT1200 system, it was possible to rework the open time lines with fewer brush strokes.

- Compared with MPG, Eastman Optifilm™ additive OT1200 significantly improves the workability of the paint.
- Not only can Optifilm™ OT1200 match the performance of MPG, but it can significantly improve upon it.
- A lower level (solids for solids) of OT1200 was able to outperform a higher level of MPG.

Figure 3. Gloss trim paint: workability of open time lines



Application performance of gloss trim paint

In addition to the open time tests, a range of other application tests were conducted and the differences against the MPG control recorded in the table below.

The results show that compared with the MPG control it is possible to significantly improve open time, wet edge, and workability without compromising paint performance.

Test	Eastman Optifilm™ additive OT1200 compared with MPG control	Comments	Test method
Open time	↑	Significant improvement with OT1200	Modified ASTM (WK13360)
Wet edge	↑	Significant improvement with OT1200	Modified ASTM (WK13360)
Workability	↑	Significant improvement with OT1200	Internal test
Sand dry time	↑	Relates to improved open time with OT1200	Ballotini glass beads
Levelling	↑	Relates to improved open time with OT1200	Internal test
Gloss	=	No differences in gloss	BS EN ISO 2813
Blocking	=	No differences in blocking	ASTM D4946
Opacity	=	No differences in opacity	ASTM D2805
Scrub	=	No differences in scrub	BS EN ISO 11998
Colour	=	No differences in colour	ASTM E1164-09a
Viscosity (low/high shear)	=	Adjusted to specification after addition of open time additive	ASTM D562-81, ASTM D4287, ASTM D2196-10
Storage viscosity (ambient/one month at 50°C)	=	Storage stability good	ASTM D562-81, ASTM D4287, ASTM D2196-10

↑ Improvement compared with MPG control

↓ No improvement compared with MPG control

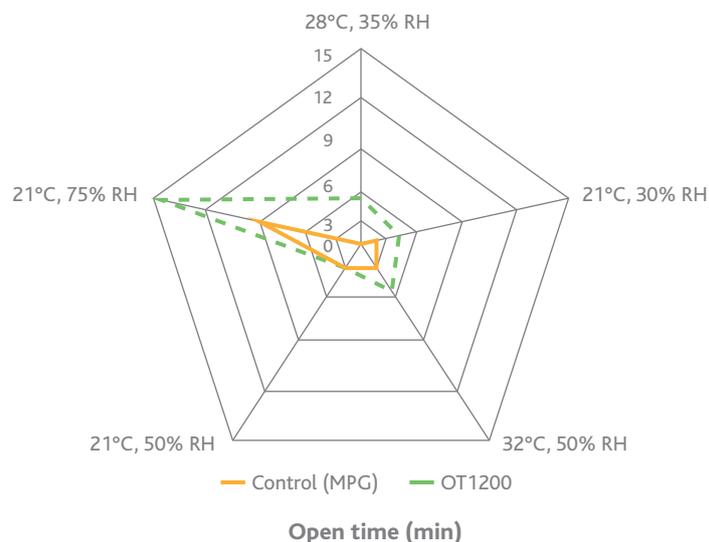
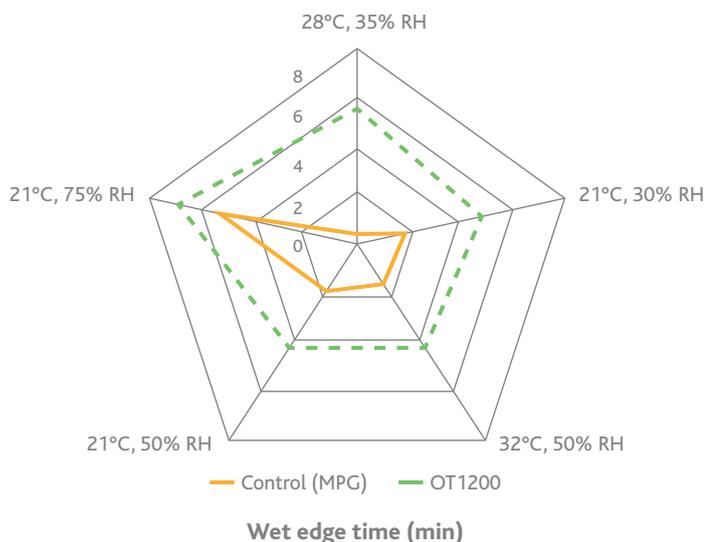
= Both MPG control and Optifilm™ OT1200 showed similar results

Open time and wet edge evaluations using the proposed ASTM method were not carried out at the same time as the workability assessment. As such, the absolute values of results may vary depending on environmental and application conditions, but the relative performance of paints containing OT1200 as compared to a control is predictable.

Robustness of a semi-gloss trim paint to varying environmental conditions

One of the challenges for the application of waterborne architectural paints is the variation in the workability that is observed when applying coatings under different environmental conditions. Open and wet edge times were evaluated in semi-gloss trim paints (based on Rhodia's Rhoplex™ SG-30) containing MPG (3%) or Eastman Optifilm™ additive OT1200 (3% actives) under five combinations of

temperature and humidity. As expected, the humectant MPG in the control paint provides poor wet edge/open time at low temperature/low humidity and good wet edge/open time at high temperature/high humidity. In contrast, the paint with Optifilm™ OT1200 provides excellent wet edge time regardless of temperature and humidity. Open times were superior for the lower VOC paints containing the OT1200 except at 21°C and 50% relative humidity (RH), where the results were relatively similar.



Conclusion

Trim paints tend to be formulated with glycols such as propylene or ethylene glycol to control open time and wet edge. These glycols are volatile organic compounds (VOCs) according to the Decopaint Directive (2004/42/EC). Eastman Optifilm™ additive OT1200 is not a VOC, and its incorporation into a variety of paint formulations will enable formulators to produce low emission and low VOC coatings that will comply with the various labelling requirements.

In this technical tip, Eastman Optifilm™ additive OT1200 has been demonstrated to be an effective low VOC option to replace MPG in a trim paint, without compromising paint performance. It has also been shown that not only can Optifilm™ OT1200 match the performance of MPG, but it can significantly improve upon it by further extending open time, wet edge, and workability of the paint. In the trim formulation, a lower level of OT1200 was able to outperform a higher level of MPG.

Appendix 1. Formulation

Table 1. Gloss trim paint (thixotropic)

Component	MPG Control	Eastman Optifilm™ additive OT1200	Type
<i>Pigment grind</i>			
Deionised water	1.0	5.9	—
Propylene glycol (100%) ^a	5.0	—	Open time additive (volatile)
Orotan™ 681 ^b	1.2	1.2	Pigment dispersant
BYK™-022 ^c	0.25	0.25	Defoamer
Ti-Pure™ R-706 ^d	21.2	20.8	White pigment
<i>Letdown</i>			
Primal™ EP-2596 ^b	56	55	Binder
Eastman Texanol™ ester alcohol ^e	3.3	3.2	Coalescent
Triton™ GR-7M ^b	0.1	0.1	Surfactant
Eastman Optifilm™ additive OT1200 ^e (69%)	—	5.0	Open time additive (non volatile)
Acrysol™ RM-2020 ^b	4.4	6.0	Thickener
Acrysol™ RM-8W ^b	0.8	1.0	Thickener
Deionised water	6.5	1.4	—
Vertec™ AT23 ^f	0.25	0.15	Thickener
Total	100	100	
PVC	17.1%	14.4%	
VOC (g/litre) Decopaint Directive 2004/42/EC	67	5.0	

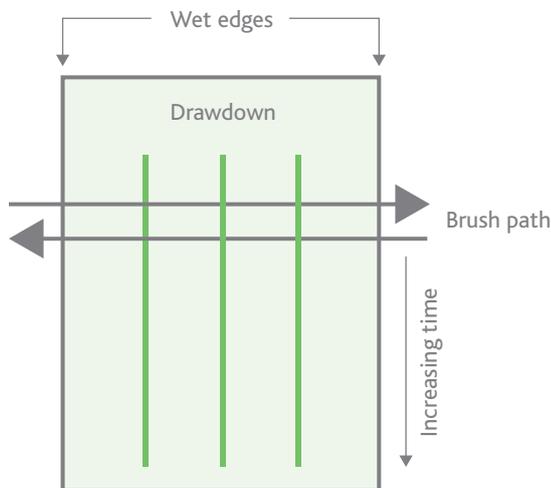
^aAldrich Chemicals, ^bDow, ^cBYK Chemie, ^dDuPont, ^eEastman Chemical Company, ^fJohnson Matthey

Incorporation and formulation adjustments

1. Eastman Optifilm™ additive OT1200 was added under low shear mixing with the other components during the letdown stage. It is important that the paint is stirred while the open time additive is being added.
2. The level of Optifilm™ OT1200 required to improve workability of an architectural paint formulation is typically in the range of 1.5% to 3.5% actives on total weight. This is only a guideline, as properties are paint dependant.
3. The following open time additives and levels were incorporated. It is to be noted that less Optifilm™ OT1200 was added compared with the level of MPG.
 - Optifilm™ OT1200 = 5% (3.5% actives at 100% solids)
 - MPG = 5% (5% actives at 100% solids)
4. Adding the Optifilm™ OT1200 reduced the rheology slightly, and the thickener levels were adjusted accordingly to meet viscosity targets.
5. Optifilm™ OT1200 contains 31% water, and the overall water level was adjusted to account for this.
6. Optifilm™ OT1200 additive has some mild coalescent activity, and as a result, an MFFT ladder may be utilized to ensure that the overall coalescent content of the paint is appropriate.

Appendix 2. Evaluation

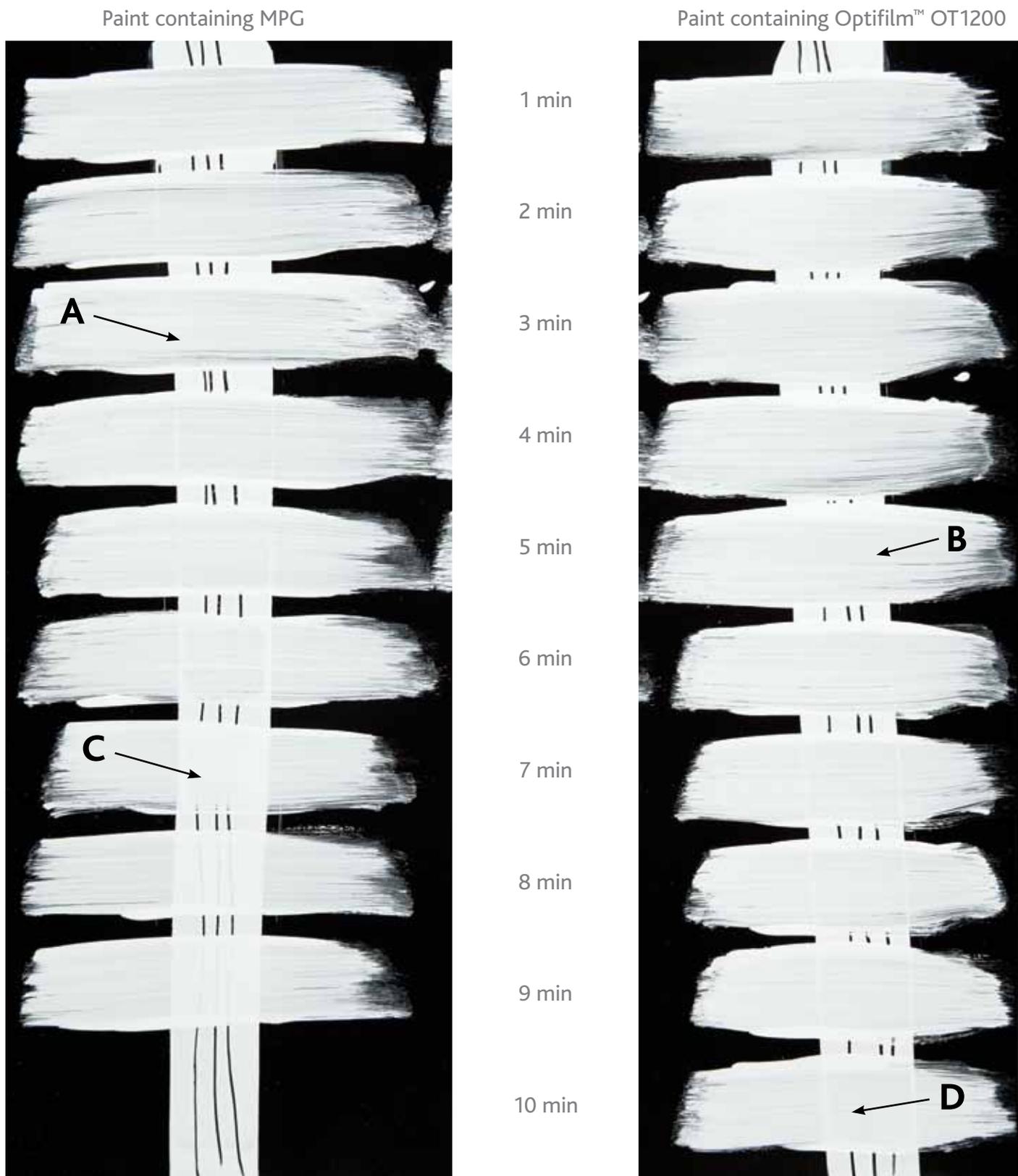
Figure 1. Typical test method for evaluation of open time and wet edge



Evaluation of open time and wet edge

Evaluations were conducted to a draft ASTM standard (ASTM WK13360). Leneta test charts were coated using a 150 μ m Wet Film Thickness (WFT) block applicator. Immediately after the paint was applied, the timer was started. Sets of three parallel lines were marked on the paint surface with the rounded end of a wooden spatula. After 1 minute, a synthetic bristle brush was used to apply the test paint by brushing in a perpendicular direction to the parallel lines, using 10 strokes of alternating direction (1 stroke = 1 back and forth motion). The test was repeated on a new section at 1 minute intervals. The test was continued until the parallel lines became visible. When the lines became visible, this was reported as the open time. The brush was lightly wetted with the test paint before each application. The test panel was dried in the horizontal position at 23°C for 24 hours before noting the parallel lines became visible (open time). As part of the same test, the time the edge became visible (wet edge) was also noted.

Figure 2. Photograph of open time and wet edge improvement of trim paint containing either MPG or Eastman Optifilm™ additive OT1200 (see Figure 1).



A indicates wet edge line appearing after 3 minutes

B indicates wet edge line appearing after 5 minutes

C indicates open time lines cannot be brushed through after 7 minutes

D indicates open time lines cannot be brushed through after 10 minutes



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