EASTMAN

Eastman
cellulose esters

Coil coatings—improving efficiency, enhancing aesthetics

Understanding the market, providing solutions

Eastman has always believed that market-driven solutions are the best solutions, providing superior products, service, and value to our customers.

Understanding our customer's needs and those of our customer's customers allows us to develop solutions to rapidly shifting market trends for formulators and end users.

Eastman high-performance CAB additives help coil coatings manufacturers optimize performance.

Coil coaters are searching for products that will allow them to gain efficiency and produce better finishes. Eastman CAB additives achieve both: increasing line speeds while ensuring a higher quality finished product.

Eastman understands that high quality specialty finishes are particularly important in today's global marketplace. For example, Europe is experiencing increased consumer interest in brightly colored household appliances with metallic, pearlescent, and high-gloss finishes. With major consumer appliance companies supplying products globally, coil coatings manufacturers must quickly adapt their products to changing global consumer trends to remain competitive.

The building and construction market sees robust demand for decorative metallic façade and cladding applications, presenting its own challenges and opportunities for coil coatings manufacturers and coil production facilities worldwide.

Eastman CAB enhances efficiencies and reduces waste through fewer rejects and reduced need for recoating—while substantially improving finished outcomes.

Speeding up the line, enhancing the aesthetics

Eastman CAB provides the ideal solution to coil coatings manufacturers facing this twofold challenge: allowing coil producers to quickly and efficiently manufacture finished coils, while ensuring the finished product is aesthetically pleasing.

Eastman CAB offers multifunctionality, versatility, and reliability for coil coatings manufacturers.

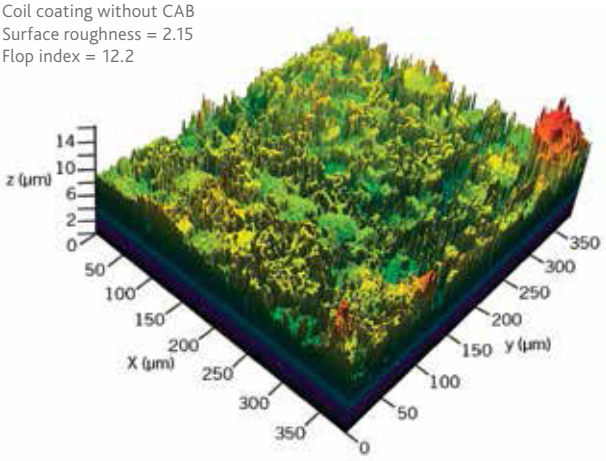
Reproduced with permission of Tata Steel

In today's market, appearance is everything.

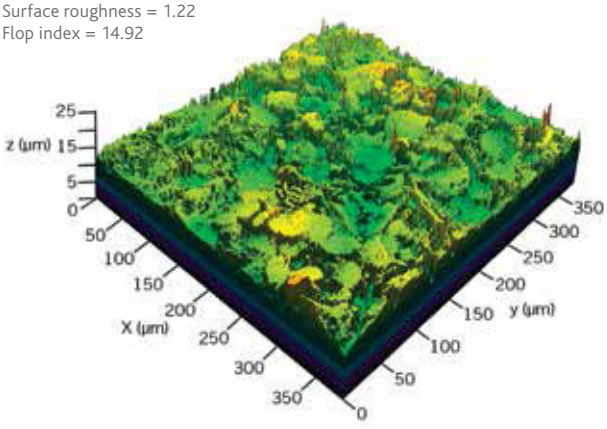
Eastman CAB is uniquely capable of improving multiple aesthetic properties of coil coatings. Multifunctional Eastman CAB additives deliver:

- Better aesthetic appeal due to improved metallic/ pearlescent flake alignment
- Fewer surface defects due to improved flow and leveling
- Better gloss consistency due to improved silica matting orientation
- Purer white color value due to improved pigment dispersion

Coil coating without CAB
Surface roughness = 2.15
Flop index = 12.2



Coil coating with 1% CAB-531-1 (100%)
Surface roughness = 1.22
Flop index = 14.92



Improved metallic/pearlescent flake alignment

Eastman CAB locks flakes in proper orientation.

The ability to control metal flake orientation is critical in producing high quality finishes. Eastman CAB acts as a viscosity control agent that "locks" the metallic and pearlescent flakes in the proper orientation. And better flake alignment means formulators require fewer flakes to achieve the same—or better—desired aesthetic impact.

The result: Beneficial cost savings for the coil coatings manufacturer.

A coating's reflectivity is maximized when viewed from the perpendicular and reduced when viewed from a shallow angle. This reflectivity change is a highly desirable property in the coil coatings industry and is called "flop." High flop values indicate that the metallic and pearlescent flakes are aligning in an even and flat manner. Coatings with higher flop values are visually brighter and more aesthetically pleasing.

Confocal microscopy uses the very latest technology to scan surfaces and build a 3D profile of the coating's surface. The roughness (RMS) of the surface is then calculated from the scanning measurements. Poor metallic or pearlescent flake alignment produces high surface roughness values while good alignment produces low surface roughness values.

The confocal microscopy image of the metallic coil coating without Eastman CAB shows a multitude of high peaks, indicating a rough surface. The image of the system containing Eastman CAB shows far fewer peaks and large domains of flat areas. The Eastman CAB-containing system has aligned the metallic flakes such that they are flatter and more even. The flop values are also in agreement with the surface roughness profiles, with the Eastman CAB-containing system producing a much higher flop value that is visually very bright. The formulation without Eastman CAB produces a far lower flop value and visually is darker with a more "grainy" appearance.

Improved flow and leveling

Eastman CAB reduces or eliminates common defects, leading to the higher gloss levels the market demands.

Leveling additives minimize irregularities in the surface and tend to have minimal effect on surface tension. Eastman CAB ensures that the coating remains smooth over the substrate after application and during curing.

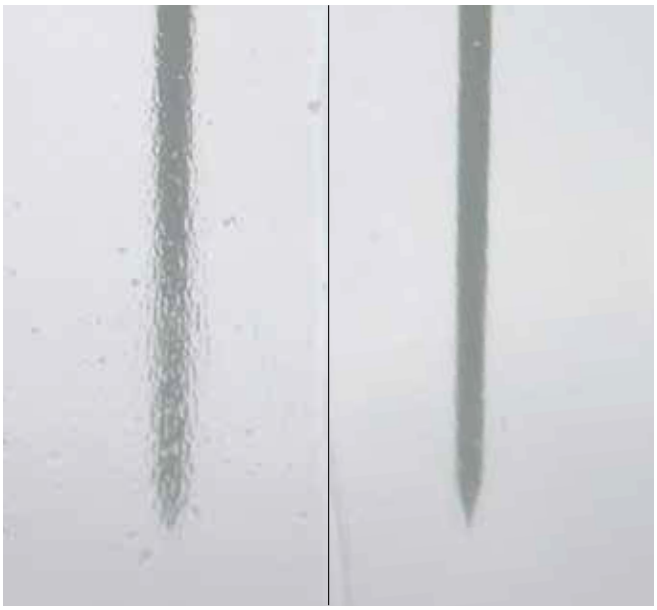
Reproduced with permission of Tata Steel

Eastman CAB can remedy common defects that degrade surface appearance. Chief among them are:

- **Orange peel**
  Uneven appearance similar to that of an orange peel
- **Fish eyes**
  Flat depressions resembling fish eyes
- **Craters**
  Bowl-shaped depressions that often have drops or bands of material at their center, in addition to raised circular ridges
- **Flooding/floating**
  If pigment concentration is uniform on the surface but not through the thickness of the film, one refers to "flooding" (horizontal separation). If, however, concentration differences are visible across the surface of the paint film, one refers to "floating" (visual separation). Flooding and floating are related to Benard cell formation in mainly solid colors, observed as a mottled, streaked, or blotchy film appearance.
- **Crawling and/or retraction**
  A phenomenon related to dewetting of the coating from the substrate and can often be observed at the edges of a panel.

Eastman CAB also acts as a "force multiplier," bringing about synergistic effects with other commonly used flow and leveling additives.

This photograph demonstrates how CAB significantly improves flow/leveling in coil coatings.



Without CAB
Poor flow/leveling
Less reflection

With CAB
Good flow/leveling
Excellent reflection

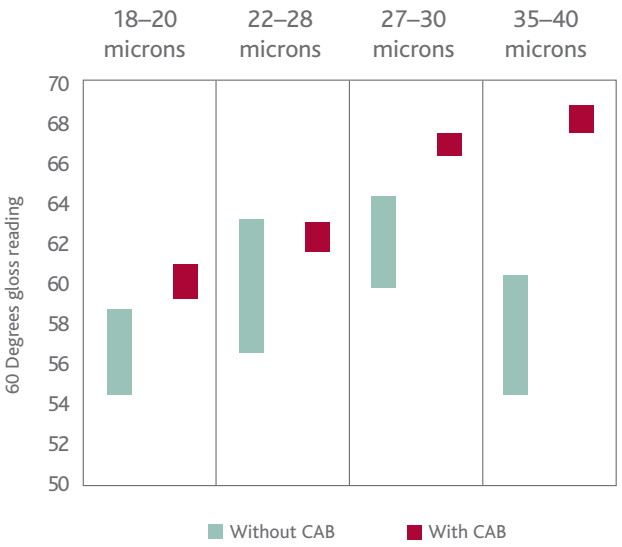
The panel without Eastman CAB is marked with a large number of craters and includes a high level of orange peel, which is unsightly and reduces surface gloss and smoothness. The reduction in gloss is highlighted in the photograph, which shows a reduction in the reflection of a pencil held above the surface. The panel containing Eastman CAB has eliminated the orange peel effect, with gloss increasing such that the reflection of the pencil is much more pronounced.

Improved silica matting consistency

Eastman CAB permits tighter gloss specifications with less variation.

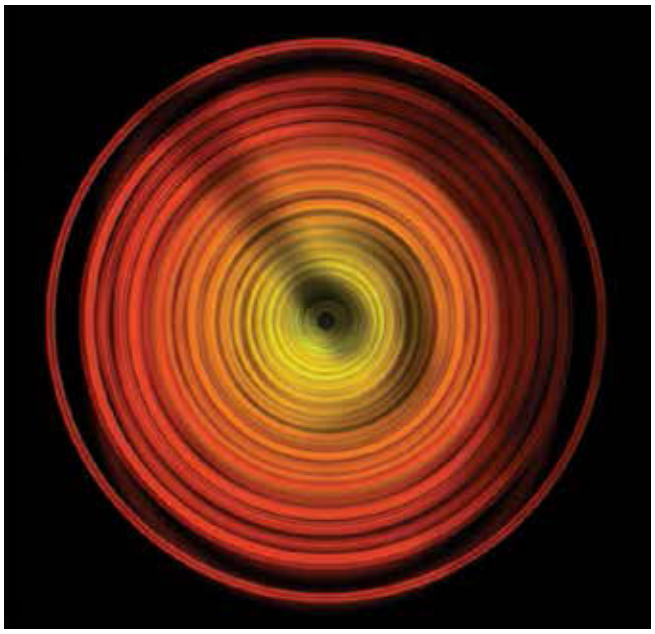
Semigloss coil coatings for the building and construction market can be subject to gloss variation across the width of 1.8-meter coil. Matting agents based on silica are one of the preferred choices in producing semigloss coil coatings.

The chart demonstrates the lower gloss variation obtained with CAB.



The chart statistically shows that Eastman CAB improves the matting consistency of a coil coating. Tighter gloss specifications were observed across the range of film thicknesses of 18–40 microns. Eastman CAB was the most effective when incorporated into the grind, where it was dispersed under high shear in the formulation in conjunction with the matting agent and titanium dioxide pigment. Incorporating Eastman CAB as a postadditive was also effective but not as effective as adding Eastman CAB into the grind.

A lower molecular weight commercial grade of Eastman CAB was also evaluated and effective at reducing gloss deviation. The lower molecular weight had less effect on increasing the final viscosity.



Eastman CAB increases line speeds 100%.

A major coil producer in Brazil turned to Eastman for help in improving its line speeds. Eastman CAB delivered a 100% increase in line efficiency.

Specializing in coating steel for the building and construction and appliance markets, this coil producer's repeated attempts to increase its 50-meter-per-minute line speeds were continually frustrated by surface imperfections, most noticeably mottling.

Working in concert with Kroma, its primary coil coatings manufacturer, Eastman CAB additives were blended into their standard coating at levels of 0.5% to 1.5% of the total formulation.

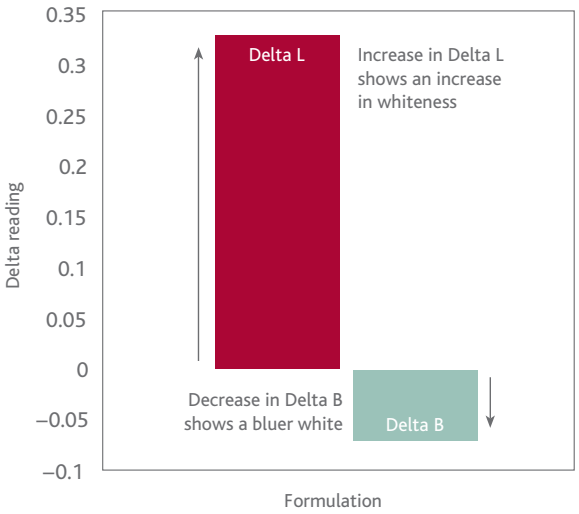
The remarkable result: The company was able to double its line speeds to 100 meters per minute while avoiding surface imperfections.

Improved pigment dispersion

Eastman CAB produces purer and deeper white coil coatings.

While titanium dioxide tends to disperse effectively in coil coatings, adding Eastman CAB directly into the grinding stage of the pigment dispersion process will significantly improve pigment dispersion compared to the system without CAB.

The chart demonstrates the impact of CAB on pigment dispersion.



The chart on the left demonstrates that Eastman CAB is beneficial in increasing the lightness value. A higher lightness value produces an increase in whiteness. Eastman CAB is also beneficial at decreasing the Delta B, resulting in a less yellow and bluer white.

How to add CAB (and value)

Eastman CAB is easily added to your preexisting formulations. The most common technique is to predissolve Eastman CAB with a suitable coil coating solvent. As the level and type of Eastman CAB used may differ based on the desired aesthetic effect and nature of substrate, different solvents may be required to achieve optimum solubility.

Eastman specialists will work closely with you to identify and implement the most effective and cost-efficient formulations.

Eastman portfolio of CAB additives

Product	Use	Level (%)
CAB-531-1 CAB-551-0.2	Metallic, pearlescent flake alignment	0.5–1.0
CAB-381-0.5 CAB-551-0.01	Matting efficiency	0.5–1.0
CAB-551-0.01	Flow and leveling	0.1–1.0
CAB-551-0.2 CAB-381-0.5 CAB-553-0.4	Pigment dispersion and codispersants	0.1–1.0
CAB-551-0.01	Increase gloss	0.1–1.0
CAB-553-0.4	Higher hydroxyl functionality can improve adhesion, reactivity.	0.1–1.0
CAB-381-20 CAB-381-2	High molecular weight. Overthinned batches can be brought into specification.	0.5–5.0

Experimental

Metallic flake alignment

To demonstrate the improved metallic flake alignment, Eastman CAB was predissolved in coil coating solvent (1:5) and added to a standard metallic polyester coil coating at a level of 5% by weight of the finished coil coating. The formulations were then applied on a coil coating pilot plant line. To assess the metallic flake alignment, confocal microscopy was used to measure the surface roughness and a multiangled spectrophotometer was used to measure the flop values.

Flow and leveling

To demonstrate improved flow and leveling, two primed aluminum panels were finished with coatings (Formulation 1), one which included Eastman CAB. Both were cured for one and a half minutes at 250°C to reach a peak metal temperature of 250°C for 10 seconds with a dry film thickness of 20–22 microns.

Formulation 1

Ingredient	Standard	0.4% CAB-551-0.01	Description	Supplier
Novasynt™ S1402-65	45.8	45.5	Saturated polyester resin	Novaresine
Cymel® 303 LF	7.6	7.5	Melamine cross-linking agent	Allnex
CAB-551-0.01	0	0.4*	Cellulose ester	Eastman Chemical Company
PM acetate	3.9	3.9*	Solvent	Eastman Chemical Company
Loxanol® CA5308	3.9	3.9*	Dibasic ester	BASF
BAS™ 150	7.7	7.7*	Aromatic 150 solvent	Samuel Banner & Co., Ltd.
Tioxide™ TR81	28.7	28.7	Titanium dioxide pigment	Huntsman
Nacure™ 1051	0.4	0.4	Sulphonic acid catalyst	King Industries
Eastman Optifilm™ enhancer 300	2	2	Retarder solvent	Eastman Chemical Company
BAS™ 150	0	1.2	Retarder solvent	Samuel Banner & Co., Ltd.

**Preblended*

Matting consistency

To demonstrate the improved matting efficiency obtained with Eastman CAB, a standard white polyester melamine formulation (Formulation 2) was prepared with and without Eastman CAB, which was dispersed into the resin with the matting agent and pigment.

To measure matting consistency, the formulations were coated at four different film thicknesses. Five gloss measurements were taken of each panel at 20°, 60°, and 85°C. The coatings were cured in a Werner Mathis oven at 250°C for one and a half minutes, which gave a peak metal temperature of 232°C for 10 seconds.

Formulation 2

Ingredient	Formulation A	Formulation B	Description	Supplier
Novasynt™ S1441-70	45.5	45.5	Saturated polyester resin	Novaresine
Cymel® 303 LF	7.5	7.5	Melamine cross-linking agent	Allnex
CAB-381-0.5	0	1	Cellulose ester	Eastman Chemical Company
PM acetate	3.35	3.35	Solvent	Eastman Chemical Company
Loxanol® CA5308	3.35	3.35	Dibasic ester	BASF
BAS™ 150	6.7	6.7	Aromatic 150 solvent	Samuel Banner & Co., Ltd.
Tioxide™ TR81	28.7	28.7	Titanium dioxide pigment	Huntsman Tioxide
Acematt® OK 500	2.1	2.1	Silica matting agent	Evonik Industries
Nacure™ 1051	0.4	0.4	Sulphonic acid catalyst	King Industries
CAB-551-0.01	0.4	0.4	Flow aid	Eastman Chemical Company
Eastman Optifilm™ enhancer 300	2	2	Retarder solvent	Eastman Chemical Company

Pigment dispersion

To demonstrate the improved pigment dispersion properties of Eastman CAB, a coil coating formulation (Formulation 3) was applied on an aluminum substrate with a dry film thickness of 20 microns. The coatings were cured in a Werner Mathis oven at 250°C for one and a half minutes, which gave a peak metal temperature of 232°C for 10 seconds.

The panels were measured for Delta L and Delta B values using a Minolta Spectrophotometer CM3600d at four points on the coil coating. Delta L is a measure of lightness/whiteness and Delta B is a measure of yellowness and blueness.

Formulation 3

Ingredient	Standard	Formulation A	Description	Supplier
Novasynt™ S1402-65	45.5	44.4	Saturated polyester resin	Novaresine
Cymel® 303 LF	7.5	7.3	Melamine cross-linking agent	Allnex
CAB-551-0.2	0	1	Cellulose ester	Eastman Chemical Company
PM acetate	3.9	3.9	Solvent	Eastman Chemical Company
Loxanol® CA5308	3.9	3.9	Dibasic ester	BASF
BAS™ 150	7.7	7.7	Aromatic 150 solvent	Samuel Banner & Co., Ltd.
Tioxide™ TR81	28.7	28.7	Titanium dioxide pigment	Huntsman Tioxide
Nacure™ 1051	0.4	0.4	Sulphonic acid catalyst	King Industries
CAB-551-0.01	0.4	0.4	Flow aid	Eastman Chemical Company
Eastman Optifilm™ enhancer 300	2	2	Retarder solvent	Eastman Chemical Company
Xylene	0	0.3	Solvent	Samuel Banner & Co., Ltd.
Nonvolatile content	68.5	68.5		

Formulation 3 was prepared in the following order:

Grind stage

1. Novasynt™ S1402-65 blended with Cymel® 303 LF in a 250-mL sample tin
2. TR81 and Eastman CAB-551-0.2 (Formulation A) premixed and added slowly to resin while mixing at a shear rate of 11–12 Ncm
3. After 40 minutes, checked dispersion to Hegman gauge reading of < 5 µm

Letdown stage

4. All other ingredients blended together and added slowly to pigment dispersion
5. Dispermat shear dropped to 8 Ncm for 20 minutes prior to final Hegman gauge check of < 5 µm

Eastman offers a wide variety of other specialized additives for the coil coatings industry, including:

Product	Use	Level (%)
Eastman EEP solvent	Provides high solvency, low solution viscosity, good solvent release, and excellent flow and leveling. High autoignition temperature for use at high cure temperatures.	3–30
Eastman retarder solvents	Offer lower surface tensions for improved substrate wetting, higher autoignition temperatures for use at high cure temperatures.	3–5
Resin intermediates	CHDA and CHDM produce a coil coating polymer with a good flexibility/hardness balance with good detergent/stain/salt spray/sterilization/resistance	10–50
Eastman Optifilm™ enhancer 300	In PVC plastisols, is a plasticizer/diluent. Dilutes and plasticizes at the same time. Imparts soft feel and stain resistance.	5–20

To learn how you can achieve your own competitive advantage with Eastman's CAB portfolio, call one of our representatives today.

EASTMAN

The results of insight™

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

CE-COAT-002 6/15