

COLOUR BLACK FW 255

High jet Specialty Carbon Black for solvent-borne
and water-borne Coatings

Technical Information 1393



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Introduction

For decades, Orion Engineered Carbons GmbH has been offering Specialty Carbon Blacks that meet the stringent performance requirements of premium high jetness coatings. The automotive industry, for example, uses these Specialty Carbon Blacks widely. Produced by the Furnace Black process or Degussa Gas Black process, these Specialty Carbon Blacks typically impart amazingly high jetness, and a deep blue undertone to coating films.

As regards incorporation, formulators can obtain the colorimetric properties desired when dispersion and stabilization issues of the Specialty Carbon Black are well addressed. The Specialty Carbon Black itself is characterized by a small primary particle size and narrow particle and aggregate size distribution.

COLOUR BLACK FW 255

The COLOUR BLACK FW 255 is characterized by a very small mean primary particle size, and both a narrow distribution of primary particle size and aggregate size. This particular particle design, in combination with a good dispersion, results in very high jetness and a deep blue undertone.

COLOUR BLACK FW 255 is an after-treated Specialty Carbon Black. This after-treatment process generates a functional surface with oxygen-containing groups (Figure 1). When incorporated in a coating system, these groups induce better wetting and dispersing properties. An enhanced interaction with polar binders improves the stabilization of the Specialty Carbon Black significantly.

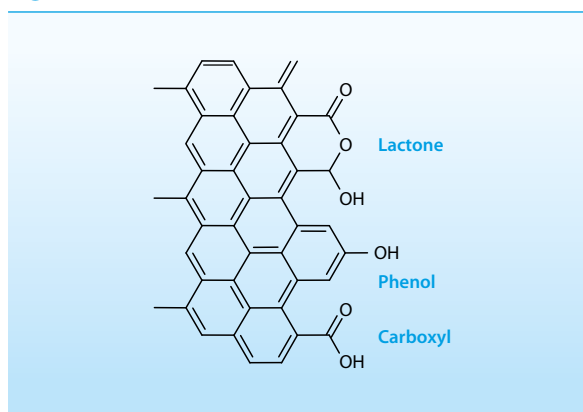
The content of volatile matter (oxidization degree) is often used to describe the content of oxygen-containing surface groups. The COLOUR BLACK FW 255 has a content of volatile matter of approximately 12% at 950°C.

Several years ago, Orion Engineered Carbons introduced COLOUR BLACK FW 171, a high jetness Specialty Carbon Black, primarily designed for the application dedicated to water-borne coatings.

Orion's most recent development based on highly sophisticated particle design - the COLOUR BLACK FW 255 - is an universal Specialty Carbon Black suitable for the application to solvent-borne as well as to water-borne coatings.

COLOUR BLACK FW 255 shows a high jetness (high M_V value)¹⁾ in solvent-borne coating systems and high jetness values in water-borne coating systems. Thus, COLOUR BLACK FW 255 can be used universally in a broad range of different coating systems.

Figure 1



Typical oxygen-containing Groups on the Surface of an after-treated Specialty Carbon Black

1) All M_V , M_C and dM values are measured through a glass plate. The colorimetric data in this TI are for guidance purposes only. They are guideline values at the time of printing.

COLOUR BLACK FW 255 in Polyurethane Coatings

a) Solvent-borne 2K PU Coating System

The colorimetric properties of COLOUR BLACK FW 255 were tested at a total Specialty Carbon Black concentration of 2.2 % in a solvent-borne 2K PU coating system, based on an acrylic binder (Figure 2).

In a first step, the pigment was wetted initially with binder and solvent by using a lab dissolver (Pendraulik LR34, 5 minutes at a peripheral speed of 8.4 m/s), followed by the milling step with a standard laboratory shaker (Skandex-Disperser DAS 200 or BA S-20), steel beads (2 mm), and a dispersing time of one hour. The concentrated paste was let down with acrylic binder, solvent, and isocyanate as curing agent. The formulation used is given in Table 1:

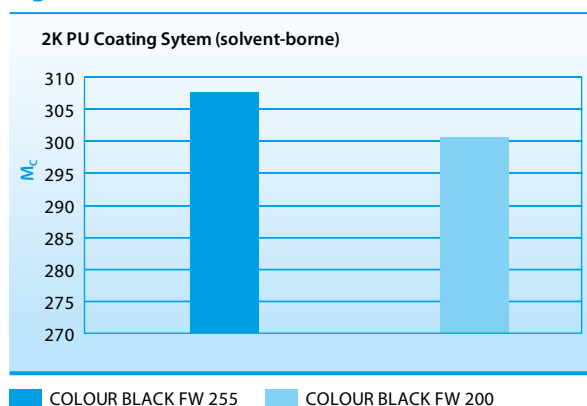
Table 1

Mill Base 2K PU Coating	
DEGALAN® VP 4157 L, 60 % (from Evonik)	68.75 g
Butyl Acetate, 98 %	23 g
COLOUR BLACK FW 255	8.25 g
Total	100 g

Let Down 2K PU Coating	
Mill Base	26.5 g
DEGALAN® VP 4157 L, 60 % (from Evonik)	47.5 g
2K-Diluent	20 g
Desmodur® N 75 MPA/X, 75 % (from Covestro)	6 g
Total	100 g
Total Quantity of Specialty Carbon Black	2.2 %

COLOUR BLACK FW 255 shows a clearly higher jetness ($M_V = 302$) with a less bluish undertone ($dM = 5.6$) compared with COLOUR BLACK FW 200 ($M_V = 289$, $dM = 11.5$). The M_C , which displays the overall visual impression of the final coating, discloses the significant improvement of COLOUR BLACK FW 255 (Figure 2).

Figure 2



Colorimetric performance of COLOUR BLACK FW 255 and COLOUR BLACK FW 200 in a solvent-borne 2K PU coating system with a total amount of SCB of 2.2 %.

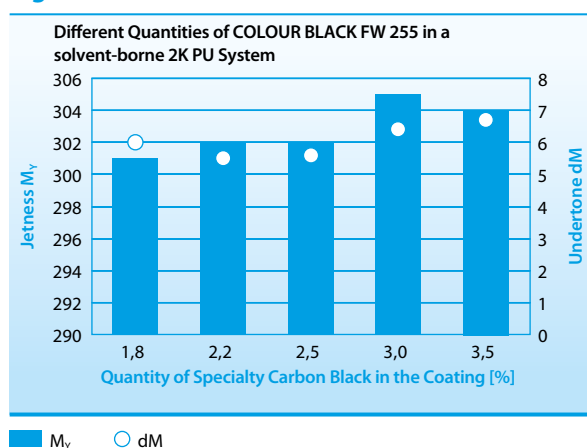
$$M_C = M_V + dM, M_V = 100 \log[100/Y], dM = M_C - M_V$$

$$M_C = 100 \{ \log[Xn/X] - \log[Zn/Z] + \log[Yn/Y] \}$$

The jetness of COLOUR BLACK FW 255 in a 2K PU coating system can be increased even up to a M_V value of 305 by increasing the total Specialty Carbon Black quantity to 3 %.

Figure 3 shows how COLOUR BLACK FW 255 quantity influences the jetness and undertone of the 2K PU coating.

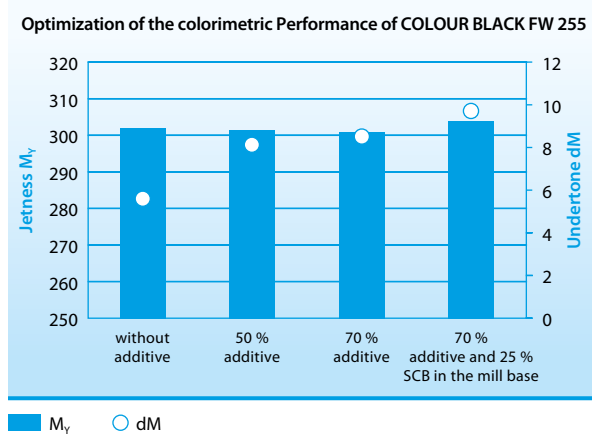
Figure 3



Increase of total quantity of COLOUR BLACK FW 255 in the final 2K PU coating and its influence on jetness (M_V , grey bars) and bluish undertone (dM , white/purple dots).

Several dispersion additives have been tested for stabilization of COLOUR BLACK FW 255 in the solvent-borne 2K PU coating system. The dispersion additive Borch® Gen 0451 from Borchers intensifies the bluish undertone of the coating and is therefore recommended. The bluish undertone was further optimized by increasing both the additive concentration and the quantity of Specialty Carbon Black (related to binder solid) in the mill base. We are able to obtain a M_V value of 304 and a dM value of 9.7 after optimization. The colorimetric results are shown in Figure 4.

Figure 4



Jetness (M_v , grey bars) and bluish undertone (dM , white/purple dots) of COLOUR BLACK FW 255 in a solvent-borne 2K PU coating system. First to third bar: 20 % Specialty Carbon Black in relation to binder solid in the mill base, fourth bar: 25 % Specialty Carbon Black in relation to binder solid in the mill base. The percent values given for the amount of additive (Borchi® Gen 0451) are related to binder solid in the mill base. A total amount of 2.2 % SCB in the let down was used.

b) Water-borne PU Coating System:

The colorimetric properties of COLOUR BLACK FW 255 were also tested in a water-borne 1K PU coating system with a binder free mill base.

To improve the dispersion of the pigment, and to stabilize the mill base, one use between 50 % and 100 % (g/g) active wetting agent related to COLOUR BLACK FW 255. A very suitable additive for this purpose is TEGO Dispers® 760W (Evonik, 35 % active). The pigment was wetted with a dissolver (Pendraulik LR34, 5 minutes at a peripheral speed of 8.4 m/s), followed by a milling step with a laboratory shaker (Skandex-Disperser DAS 200 or BA S-20) and chromanit-steel beads (3 mm) for one hour. Table 2 shows the formulation for a binder free mill base, the formulation of a 1K PU binder system, and the let down of the mill base with the 1K PU binder system.

Table 2

Binder-free Mill Base	
Deionised Water	44.5 g
TEGO Dispers® 760W, 35 % (from Evonik)	36 g
TEGO Foamex® 830 (from Evonik)	1 g
DMEA (Neutralization Agent)*	0.5 g*
COLOUR BLACK FW 255	18 g
Total	100 g
Ratio Wetting Agent to Specialty Carbon Black	70 %
Total Quantity of Specialty Carbon Black	18 %

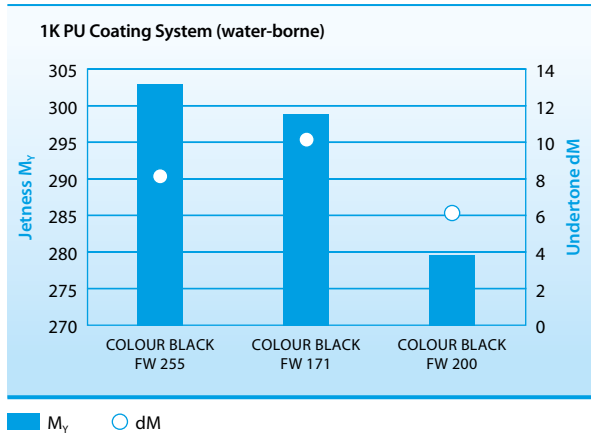
Formulation of 1K PU Binder System	
Alberdingk® U9800, 35 % (from Alberdingk & Boley)	75.8 g
Butyl Glycol	13 g
Deionised Water	10 g
BYK®-015 (from BYK)	0.6 g
TEGO Wet® 280 (from Evonik)	0.4 g
DMEA (Neutralization Agent)	0.2 g
Total	100 g

Let Down with 1K PU Binder System	
Mill Base	8.5 g
1K PU Binder System	91.5 g
Total	100 g
Total Specialty Carbon Black Concentration	1.5 %

*has to be adjusted to a pH value of 8.2 – 8.7 after dispersion.

In the tested water-borne 1K PU coating system, COLOUR BLACK FW 255 shows a very high jetness that outperforms even COLOUR BLACK FW 171 (Figure 5). The bluish undertone is slightly less pronounced than that of COLOUR BLACK FW 171.

Figure 5

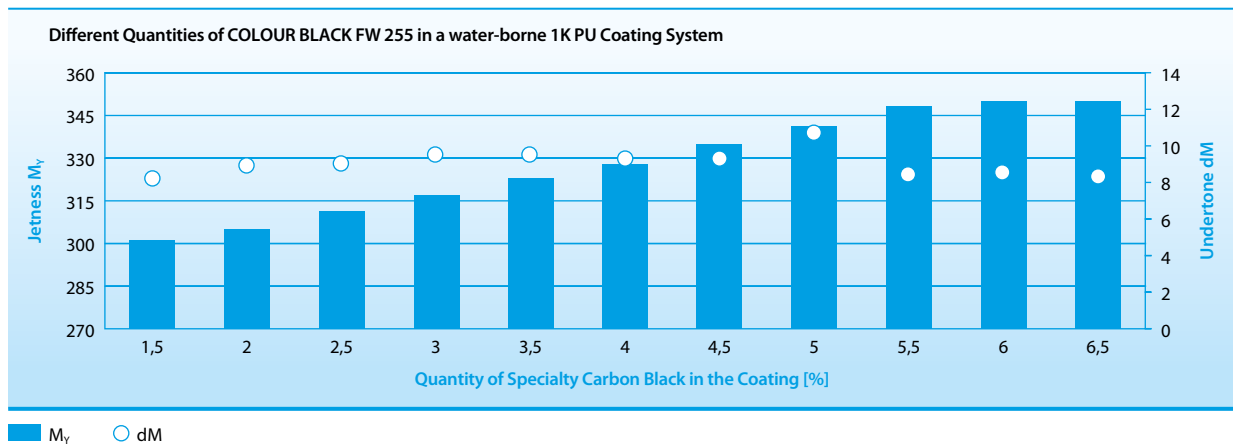


Jetness (M_v , grey bars) and bluish undertone (dM , white/purple dots) of COLOUR BLACK FW 255, COLOUR BLACK FW 200 and COLOUR BLACK FW 171 in a water-borne 1K PU coating with a total amount of SCB of 1.5%.

Figure 6 demonstrates the colorimetric development on jetness and undertone in a 1K PU water-borne system with increasing concentration of COLOUR BLACK FW 255. Again, the increase of the total quantity of COLOUR BLACK FW 255 to 6% results in a jetness M_v value of 350, while the undertone stays in the same range.

In polyurethane coatings – both solvent-borne and water-borne coating systems – COLOUR BLACK FW 255 shows very high jetness and a very bluish undertone. Therefore, this product can be used as universal pigment in both water-borne and solvent-borne PU coating systems.

Figure 6



Increase of total quantity of COLOUR BLACK FW 255 in the final water-borne 1K PU coating and its impact on jetness (M_v , grey bars) and bluish undertone (dM , white/purple dots)

COLOUR BLACK FW 255 in Alkyd/Melamine stoving Enamel Coatings

The colorimetric properties of COLOUR BLACK FW 255 were tested at a total Specialty Carbon Black concentration of 2.2 % in a solvent-borne alkyd/melamine stoving enamel.

First, the pigment was initially wetted with binder and solvent by using a lab dissolver (Pendraulik LR34, 5 minutes at a peripheral speed of 8.4 m/s), afterwards the mill base was ground with a standard laboratory shaker (Skandex-Disperser DAS 200 or BA S-20), steel beads (2 mm), and a dispersing time of one hour. The concentrated paste was let down with alkyd binder, solvent, and melamine as curing agent. The formulation used, is given in Table 3.

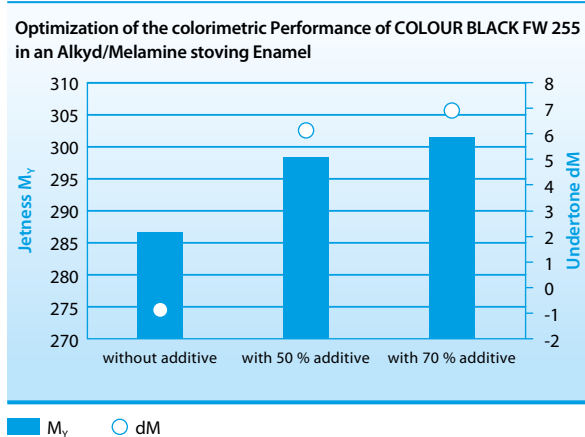
Table 3

Mill Base AK/MF Stoving Enamel:	
Setal® A F 310 SN, 60 % (from Allnex)	68.75 g
Shellsol® A	23 g
COLOUR BLACK FW 255	8.25 g
Total	100 g
Let Down AK/MF Stoving Enamel:	
Mill Base	26.5 g
Setal® A F 310 SN, 60 % (from Allnex)	33 g
MAPRENAL® MF 800/551B, 55 %* (from Ineos Melamines)	24 g
Diluent	16.5 g
Total	100 g
Total Quantity of Specialty Carbon Black	2.2 %

*weight ratio Alkydal (solid): MAPRENAL® (solid) = 70:30

COLOUR BLACK FW 255 was formulated in an alkyd/melamine stoving enamel varying the concentration of dispersing additive Borch® Gen 0451 from Borchers in the mill base. The colorimetric results are given in Figure 7. A strong increase of jetness and bluish undertone can be observed. With 70 % additive (related to binder solid) in the mill base, a jetness M_V of 302 and a dM value of 7 can be achieved.

Figure 7



Jetness (M_V , grey bars) and bluish undertone (dM, white/purple dots) of COLOUR BLACK FW 255 in an alkyd/melamine stoving enamel. 20 % Specialty Carbon Black related to binder solid in the mill base. The percent values given for the amount of additive (Borch® Gen 0451 from Borchers) are related to binder solid in the mill base. A total amount of 2.2 % SCB in the let down was used.

Summary

COLOUR BLACK FW 255 with its tailored and well balanced properties, offers formulators a broad range of possibilities for high jet coatings – not only in automotive applications. This new Specialty Carbon Black shows superior properties and can be equally used in solvent-borne and water-borne polyurethane coating systems.

In polyurethane coatings – both solvent-borne and water-borne coating systems – COLOUR BLACK FW 255 displays high jetness and strong bluish undertone. Jetness and undertone can further be maximized by using dispersion additives and optimizing the total quantity of COLOUR BLACK FW 255 in the mill base and final lacquer.

The universal usage of COLOUR BLACK FW 255 in water- and solvent-borne PU coating systems offers as well a major advantage to formulators.

In alkyd/melamine stoving enamels high colorimetric values can be achieved with COLOUR BLACK FW 255 by adding dispersing additives.

For the development of high jet coatings with deep blue undertone, we recommend to test the COLOUR BLACK FW 255 along with our well established products COLOUR BLACK FW 171 and COLOUR BLACK FW 200.



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