Improved Coating Performance with Gas Blacks

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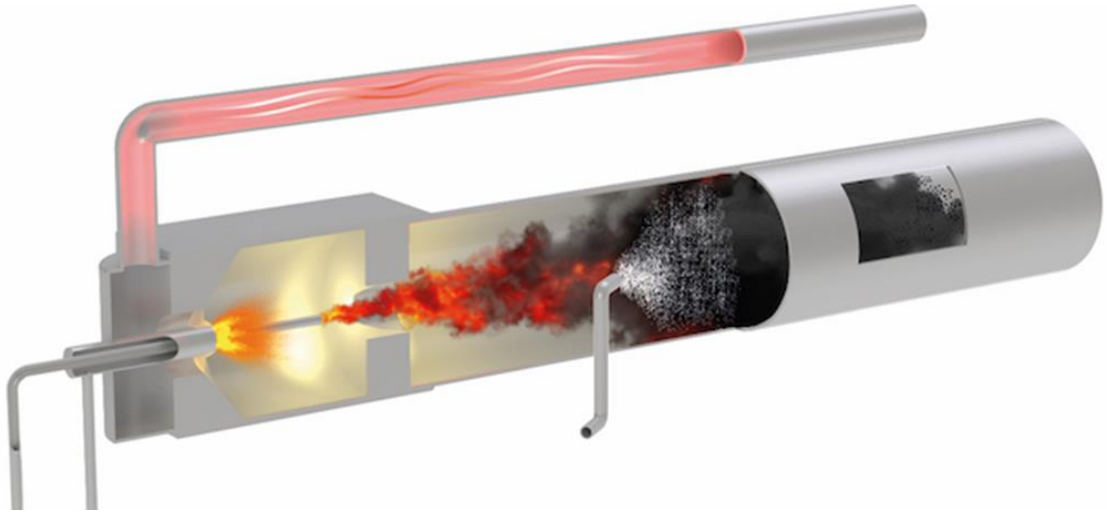
Uses for Different Carbon Black Processes

Furnace Black	Gas Black	Lamp Black
		
Tire		
MRG	MRG	MRG
Plastics	Plastics	Plastics
Printing	Printing	
Coatings	Coatings	Coatings
Sealants	Sealants	
Batteries	Batteries	

Furnace Black Process

- Most common and most variable process (primary particles, structure, porosity, aggregate size distribution)
- Liquid material sprayed into a heat source (gaseous hydrocarbons)
- Reaction is confined to a refractory-lined furnace
- After structure formation, quenching is introduced
- Alkaline oxides formed on carbon black surface (pH ~8-9)
- 98% of carbon black worldwide is produced by furnace black process
- Widely used since the surface area and structure can be controlled by temperature, additive adjustment and feed rate, and residence time

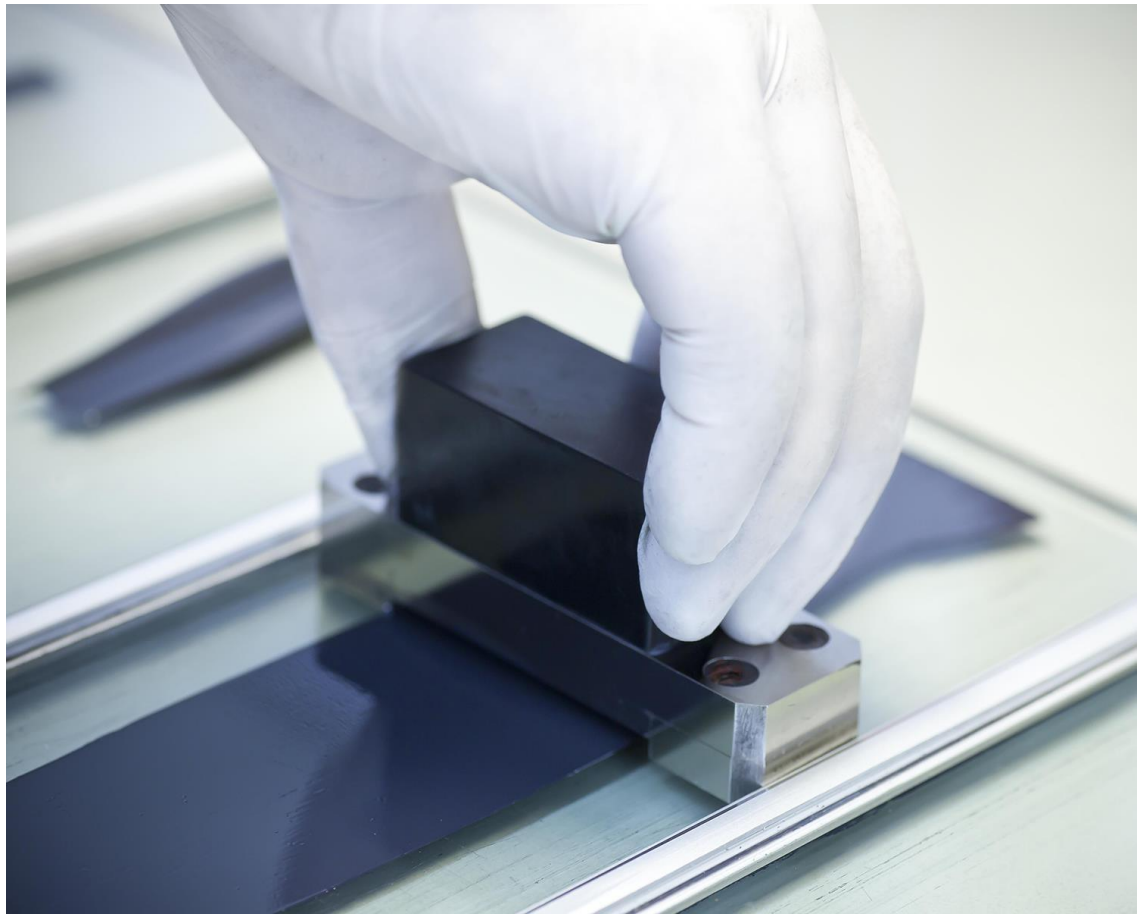


Gas Black Process

- Unique to Orion
- Open reaction system allowing air to enter introducing more oxygen
- Acidic oxygen containing surface groups formed (pH ~3.5) when in contact with oxygen at high temperature
- Acidic naturally, does not require high level of surface treatment
- Only primary particle size influenceable with narrow particle size distribution
- Primary particle size ranging from 10-30nm
- Highly porous and structured carbon blacks formed

Carbon Black Properties

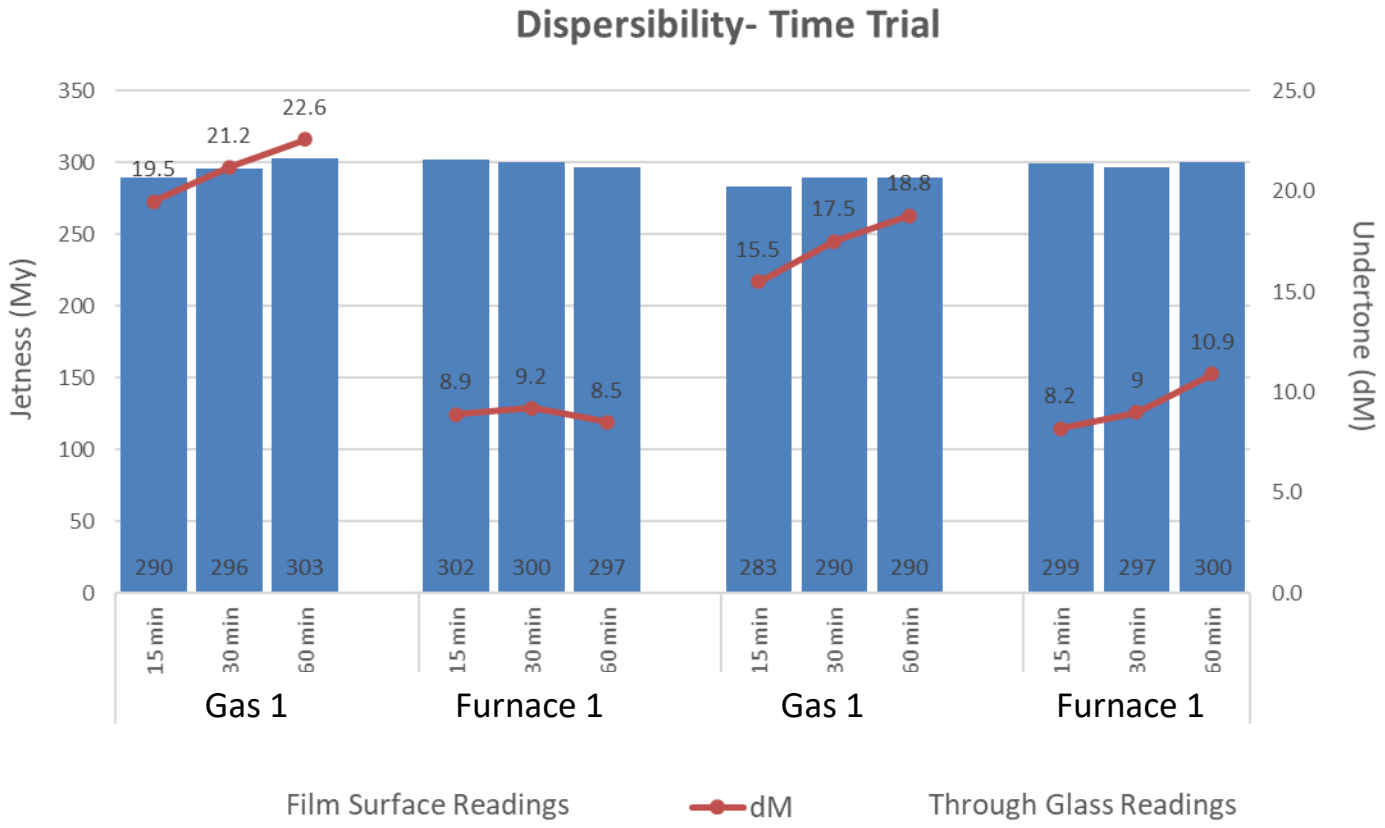
Product	Volatile Matter at 950°C (%)	Oil Absorption Number (OAN)	Surface area (m^2/g)	Primary particle size (nm)
Gas Black 1	20	160	550	13
Gas Black 2	18	142	450	17
Gas Black 3	14	115	180	25
Furnace Black 1	10.5	95	583	8
Furnace Black 2	9	110	343	16
Furnace Black 3	2.7	66	122	21



High Jetness Application

- With the same grind time, Gas Black 1 provides better appearance compared to Furnace Black 1
- Gas Black 1 also exhibits significantly bluer undertone

	Disperse Time (min)	Gas Black 1	Furnace Black 1
Grind	15	5	$5^{1/2}$
	30	$6^{1/2}$	$6^{1/2}$
	60	8	8
Gloss 20°	15	80.6	79.6
	30	81.8	78.0
	60	82.5	81.8
Haze	15	12.1	39.8
	30	4.0	27.7
	60	1.9	10.8



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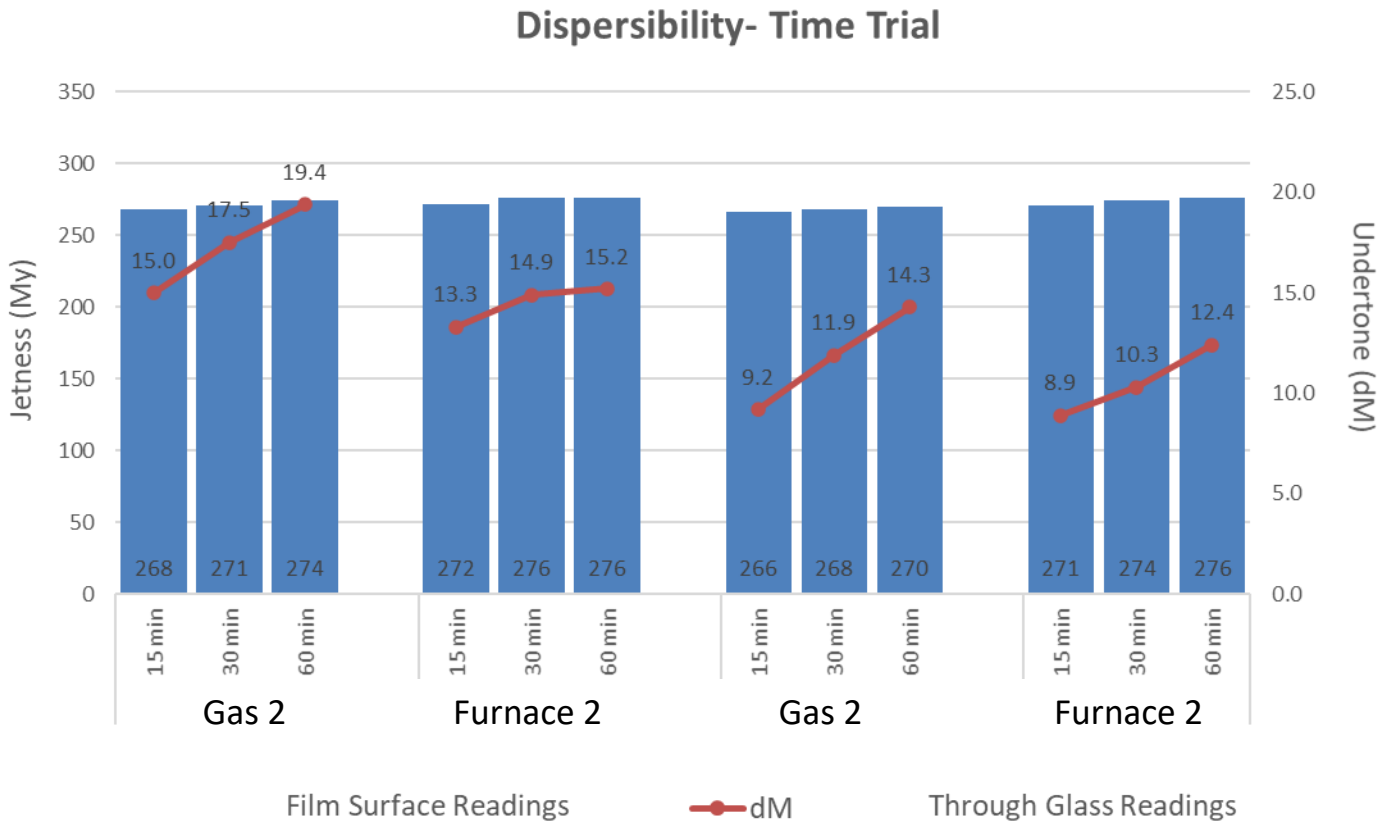
Medium-High Jetness Application

- Gas Black 2 has better appearance with the same dispersed time and better undertone

	Disperse Time (min)	Gas Black 2	Furnace Black 2
Grind	15	$6^{1/4}$	6
	30	$7^{1/2}$	$7^{1/2}$
	60	8	8
Gloss 20°	15	80.1	80.9
	30	81.0	81.6
	60	80.6	82.7
Haze	15	4.2	15.7
	30	1.2	9.2
	60	4.9	3.6



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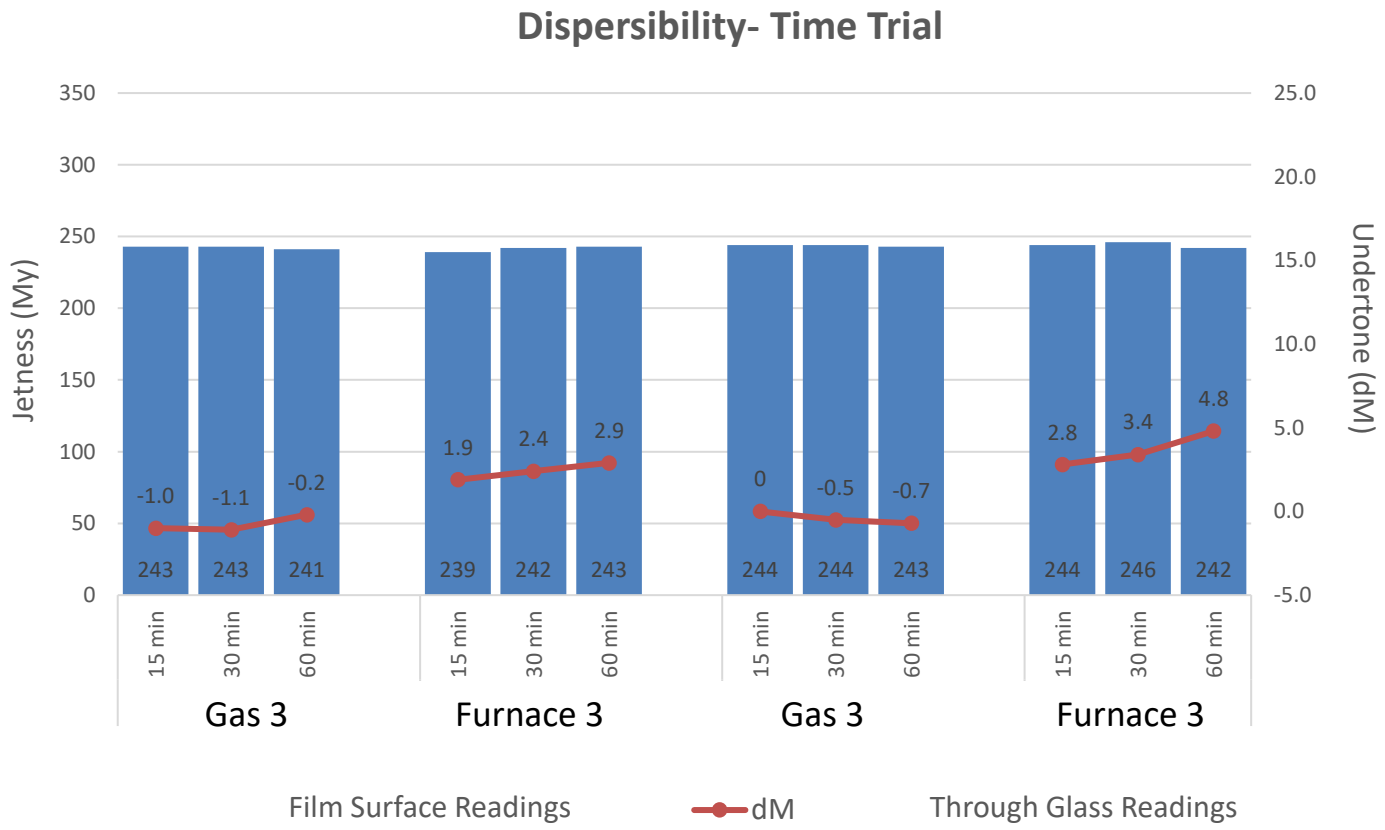
Low-Medium Jetness Application

- Gas Black 3 exhibits same similar appearance and jetness as its furnace black counterpart.

	Disperse Time (min)	Gas Black 3	Furnace Black 3
Grind	15	8	8
	30	8	8
	60	8	8
Gloss 20°	15	74.6	75.2
	30	77.6	76.7
	60	77.8	77.3
Haze	15	57.8	49.1
	30	29.5	33.5
	60	24.8	27.2



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Tint Strength Development

- Measurement stopped after hitting 100%
- Gas Black 3 was used as control to compare tint strength
- This shows the dispersibility and color development of each grade
- Gas Blacks develop faster and stronger tint strength

Time (min)	Gas Black 1	Furnace Black 1	Gas Black 2	Furnace Black 2	Gas Black 3	Furnace Black 3
5	97.74	47.63	98.34	74.93	100.07	93.68
15	98.22	70.62	98.01	86.96	-	99.21
30	101.55	86.89	102.20	93.77	-	-

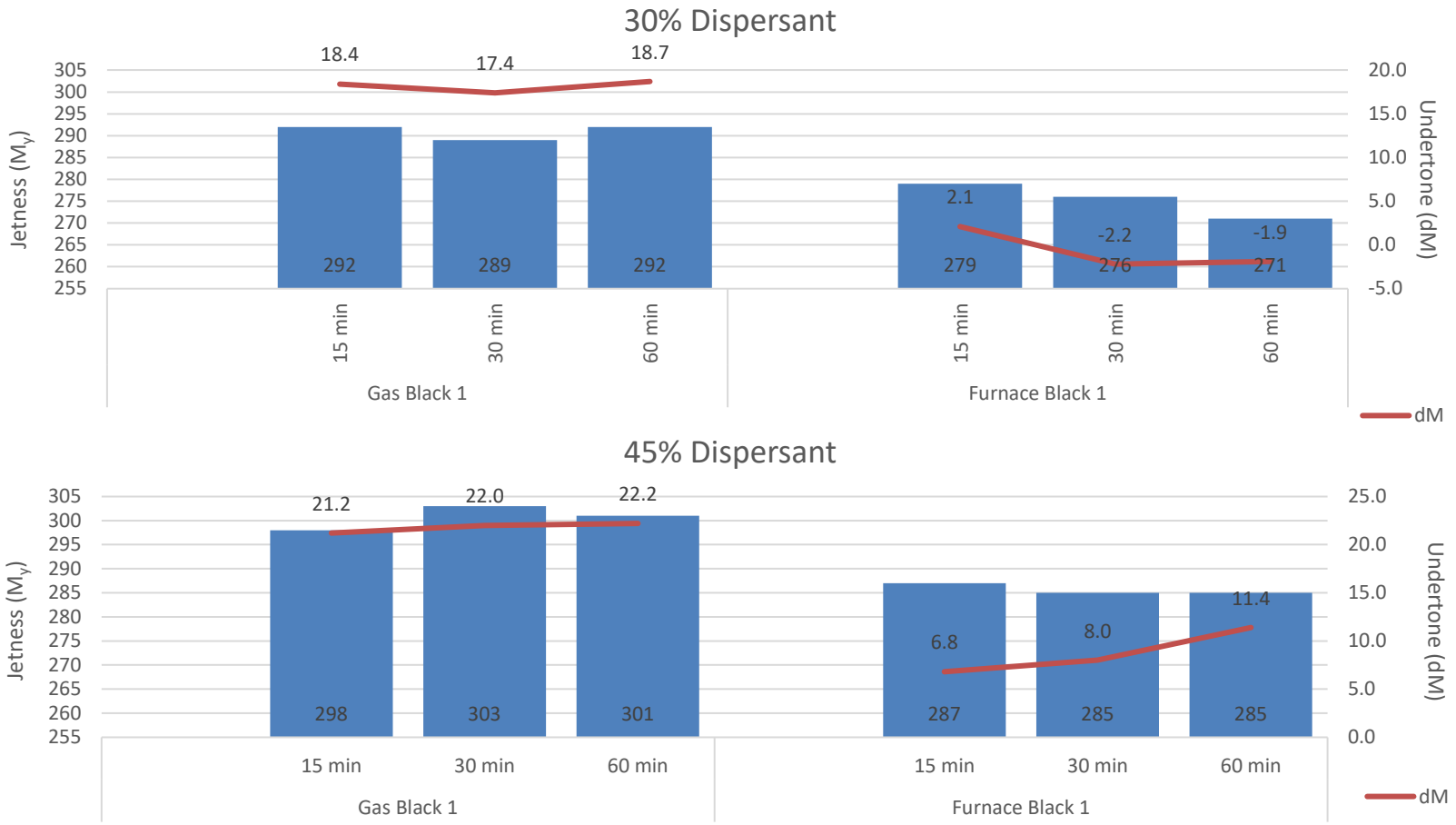
High Jetness Application

- Processing at standard time
- Gas Black 1 exhibits higher color performance at different dispersant dosage

	60% Dispersant on Pigment				45% Dispersant on Pigment				30% Dispersant on Pigment			
	M_y	dM	Gloss at 20°	Haze	M_y	dM	Gloss at 20°	Haze	M_y	dM	Gloss at 20°	Haze
Gas Black 1	303	22.6	82.5	1.9	301	22.2	83.2	4.9	292	18.7	83.2	4.9
Furnace Black 1	297	8.5	81.8	10.8	285	11.4	81.9	9.5	271	-1.9	81.9	9.5

High Jetness Application

- Gas black 1 achieved higher performance at various dispersant loads



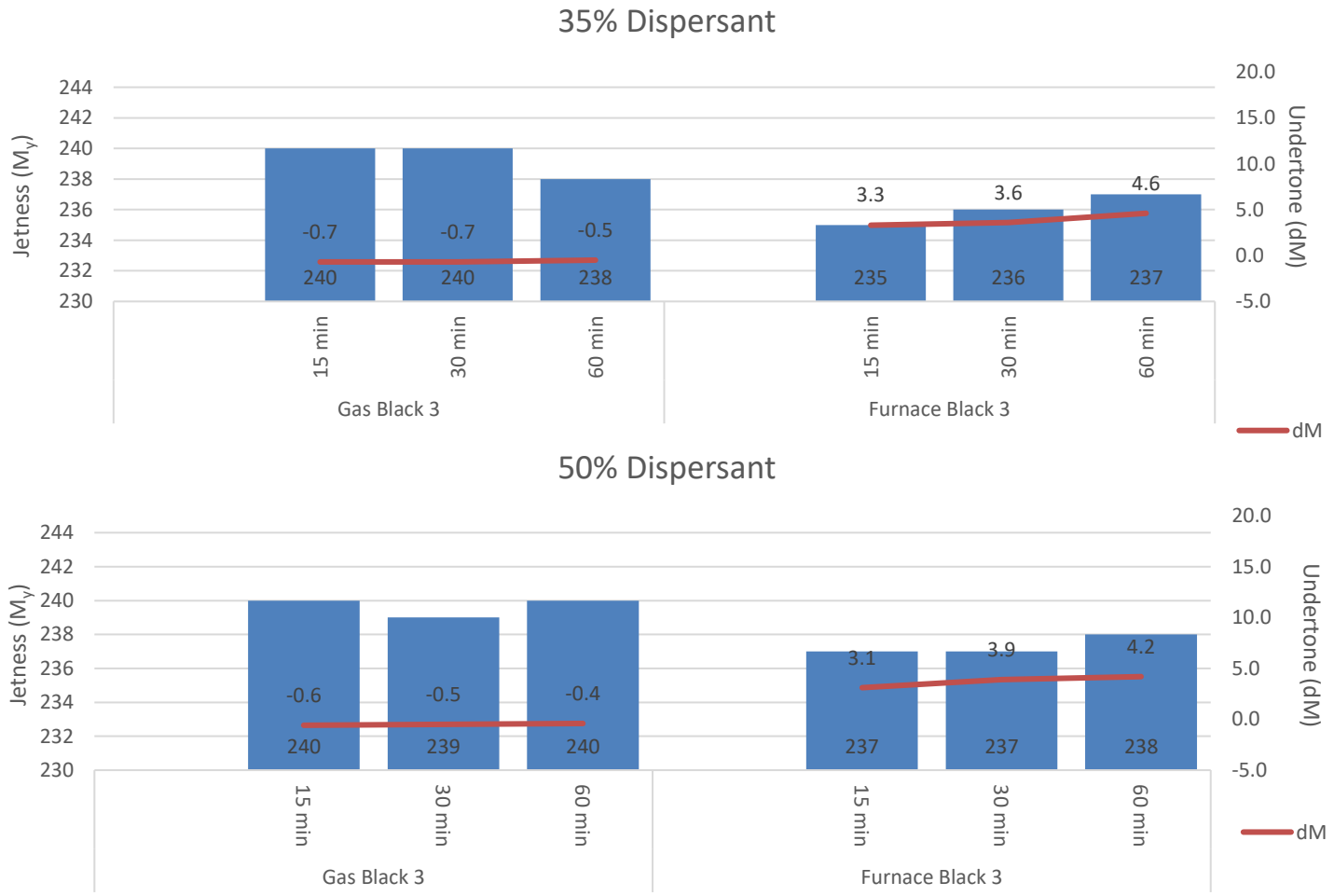
Low-Medium Jetness Application

- Processing at standard time
- Gas Black 3 reached maximum color performance at lower dosage indicating higher dispersibility

	70% Dispersant on Pigment				50% Dispersant on Pigment				35% Dispersant on Pigment			
	M_y	dM	Gloss at 20°	Haze	M_y	dM	Gloss at 20°	Haze	M_y	dM	Gloss at 20°	Haze
Gas Black 3	241	-0.2	77.8	24.8	240	-0.4	77.4	25.1	238	-0.5	77.3	25.9
Furnace Black 3	242	2.6	77.3	27.2	238	4.2	77.2	32.6	237	4.6	77.5	32.7

Low-Medium Jetness Application

- Gas black 3 achieved higher performance at various dispersant loads



Summary

- Lower need for post surface treatment
  - Improved dispersibility and stability
- Highly controlled primary particle size
  - Consistent jetness with desireable blue undertone
- Higher Oil Absorption Number
  - Higher structure to provide higher shear force during dispersing process and easier to disperse compared to low structure

Thank you!

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