

## Green Color Concentrate using TIOPREM®

*Part 1 - Matching a Color with & without TIOPREM®, then making a color concentrate.*

*(Note: It is critical to keep the total pigment weight equal for each formulation as highlighted in red)*

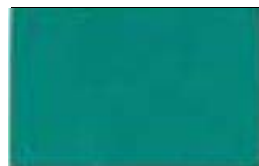
### Color ID: GREEN

Parts per Hundred Resin (pHR) Pigment Loading = 25

<u>Pigments</u>	without TIOPREM® TiO <sub>2</sub>	with TIOPREM® TiO <sub>2</sub>
	% wt.	% wt.
Raven 14 Carbon Black	0.25	0.18
BASF: L-8690 PT Green	28.00	24.00
Colortherm 20	19.50	17.33
TIOPREM® BEIGE W	0.00	38.00
DuPont R-350 White	<u>52.25</u>	<u>20.50</u>
	<b>100.00</b>	<b>100.00</b>

### Extrusion Formula: Linear Low Density Polyethylene (LLDPE)

<u>Raw Material</u>	without TIOPREM® TiO <sub>2</sub>		with TIOPREM® TiO <sub>2</sub>	
	pHR	%F.W.	pHR	%F.W.
LLDPE	<b>100.00</b>	76.923	<b>100.00</b>	76.923
Zinc Stearate	<b>2.00</b>	1.538	<b>2.00</b>	1.538
L-207 Wax	<b>3.00</b>	2.308	<b>3.00</b>	2.308
Raven 14 Carbon Black	<b>0.06</b>	0.0481	<b>0.04</b>	0.034
BASF: L-8690 PT Green	<b>7.00</b>	5.3846	<b>6.00</b>	4.615
Colortherm 20	<b>4.88</b>	3.7500	<b>4.33</b>	3.332
TIOPREM® BEIGE W	<b>0.00</b>	0.000	<b>9.50</b>	7.308
DuPont R-350 White	<b>13.06</b>	<u>10.048</u>	<b>5.13</b>	<u>3.942</u>
	<b>130.00</b>	100.000	<b>130.00</b>	100.000



<b>CIE* Color Difference:</b>	<b>ΔL*</b>	Reference	0.27
<b>With TIOPREM® vs Without</b>	<b>Δa*</b>	Reference	0.37
	<b>Δb*</b>	Reference	0.25
	<b>ΔE*</b>	Reference	<b>0.52</b>

## Green Color Concentrate using TIOPREM®

*Part 2 - Tinting Strength Test - The color concentrates from Part 1 are letdown with equal portions of White TiO<sub>2</sub> + Virgin Resin then the corresponding color difference is compared in order to determine tinting strength.*

**Letdown Ratio (LDR) = 25:1 (25 LLDPE: 1 part concentrate)**

**The 1 Part Concentrate = 50% White TiO<sub>2</sub>: 50% Green Concentrate or 1:1**

**CONTROL**  
without TIOPREM® TiO<sub>2</sub>



**TEST**  
with TIOPREM® TiO<sub>2</sub>



	<b>L*</b>	57.79	58.67
	<b>a*</b>	-39.2	-39.01
	<b>b*</b>	4.31	4.32
<b>CIE* Color Difference:</b>	<b>ΔL*</b>	Reference	0.88
<b>With TIOPREM vs Without</b>	<b>Δa*</b>	Reference	0.19
	<b>Δb*</b>	Reference	0.02
	<b>ΔE*</b>	Reference	<b>0.9</b>

**CONCLUSION:** The small color difference measured indicates that the Tinting Strength of the Test Concentrate is equal to the Control Concentrate.

## Green Color Concentrate using TIOPREM®

*Part 3 - Opacity Test- The color concentrates from Part 1 are letdown at very high LDR's with Virgin Resin then the Opacity is determined using the spectrophotometer.*

**A. Letdown Ratio (LDR) = 100:1 (100 Parts LLDPE: 1 part concentrate)  
pHR pigment = 0.5**

CONTROL  
without TIOPREM® TiO<sub>2</sub>



OPACITY = 78

TEST  
with TIOPREM® TiO<sub>2</sub>



78

**B. Letdown Ratio (LDR) = 200:1 (200 Parts LLDPE: 1 part concentrate)**

CONTROL  
without TIOPREM® TiO<sub>2</sub>



OPACITY = 59.5

TEST  
with TIOPREM® TiO<sub>2</sub>



59

CONCLUSION:

The Opacity of the test sample is equal to the Control @ the LDR of 100:1 and is very similar @ the LDR of 200:1. These results indicate that for this color, the opacity will not be an issue when using TIOPREM®.

## Gray Color Concentrate using TIOPREM®

**Part 1 - Matching a Color with & without TIOPREM®, then making a color concentrate.**

*( Note: It is critical to keep the total pigment weight equal for each formulation as highlighted in red )*

### Color ID: GRAY

**Parts per Hundred Resin (pHR) Pigment Loading = 60**

<u>Pigments</u>	without TIOPREM® TiO <sub>2</sub>	with TIOPREM® TiO <sub>2</sub>
	% wt.	% wt.
Raven 14 Carbon Black	7.00	5.61
Ultramarine Blue	8.00	7.00
Colortherm 30	5.00	3.00
TIOPREM® GRAY	0.00	35.00
DuPont R-350 White	80.00	49.39
	<b>100.00</b>	<b>100.00</b>

### Extrusion Formula: Linear Low Density Polyethylene (LLDPE)

<u>Raw Material</u>	without TIOPREM® TiO <sub>2</sub>		with TIOPREM® TiO <sub>2</sub>	
	pHR	%F.W.	pHR	%F.W.
LLDPE	<b>100.00</b>	76.923	<b>100.00</b>	76.923
Zinc Stearate	<b>2.00</b>	1.538	<b>2.00</b>	1.538
L-207 Wax	<b>3.00</b>	2.308	<b>3.00</b>	2.308
Raven 14 Carbon Black	<b>1.75</b>	1.3462	<b>1.40</b>	1.079
Ultramarine Blue	<b>2.00</b>	1.5385	<b>1.75</b>	1.346
Colortherm 30	<b>1.25</b>	0.9615	<b>0.75</b>	0.577
TIOPREM® GRAY	<b>0.00</b>	0.000	<b>8.75</b>	6.731
DuPont R-350 White	<b>20.00</b>	15.385	<b>12.35</b>	9.498
	<b>130.00</b>	100.000	<b>130.00</b>	100.000



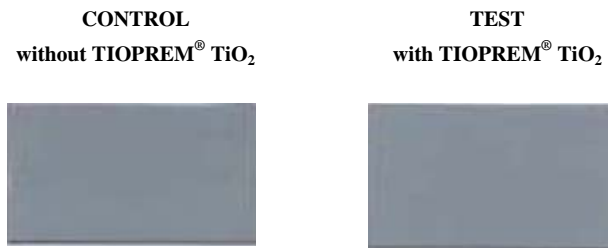
<b>CIE* Color Difference:</b>	<b>ΔL*</b>	Reference	0.21
<b>With TIOPREM® vs Without</b>	<b>Δa*</b>	Reference	-0.03
	<b>Δb*</b>	Reference	0.55
	<b>ΔE*</b>	Reference	<b>0.59</b>

## Tint Strength of Gray Color Concentrate using TIOPREM®

*Part 2 - Tinting Strength Test- The color concentrates from Part 1 are letdown with equal portions of White TiO<sub>2</sub> + Virgin Resin then the corresponding color difference is compared in order to determine tinting strength.*

**Letdown Ratio (LDR) = 25:1 (25 LLDPE: 1 part concentrate)**

**The 1 Part Concentrate = 50% White TiO<sub>2</sub>: 50% Gray Concentrate or 1:1**



	<b>L*</b>	55.79	56.42
	<b>a*</b>	-1.31	-1.4
	<b>b*</b>	-3.17	-2.82
<b>CIE* Color Difference:</b>	<b>ΔL*</b>	Reference	0.63
<b>With TIOPREM vs Without</b>	<b>Δa*</b>	Reference	-0.09
	<b>Δb*</b>	Reference	0.35
	<b>ΔE*</b>	Reference	<b>0.73</b>

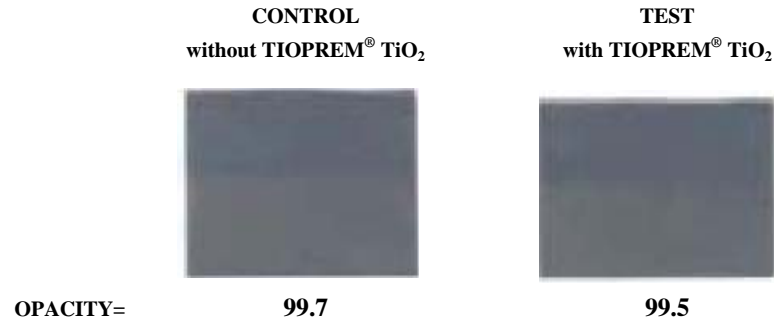
**CONCLUSION:** The small color difference measured indicates that the Tinting Strength of the Test Concentrate is equal to the Control Concentrate.

## Opacity of Gray Color Concentrate using TIOPREM®

*Part 3 - Opacity Test- The color concentrates from Part 1 are letdown at very high LDR's with Virgin Resin then the Opacity is determined using the spectrophotometer.*

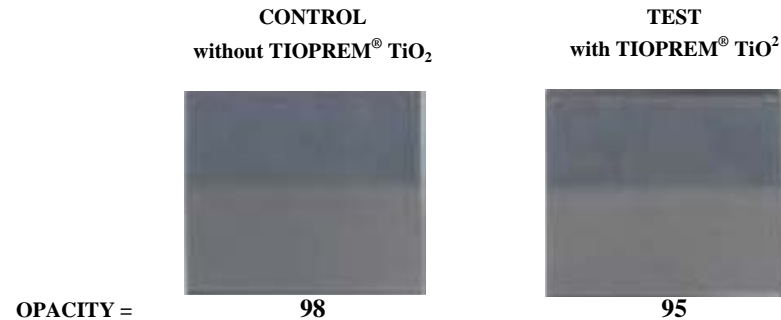
### A. Letdown Ratio (LDR) = 100:1 (100 Parts LLDPE: 1 part concentrate)

*pHR pigment = 0.5*



### B. Letdown Ratio (LDR) = 200:1 (200 Parts LLDPE: 1 part concentrate)

*pHR pigment = 0.25*



CONCLUSION:

The Opacity of the test sample is equal to the Control @ the LDR of 100:1 but is lower @ the LDR of 200:1. These results indicate that for most applications, such as injection molding, where a typical LDR of 25:1 is used the opacity obtained will be equal; however, for those applications which require LDR's of more than 100:1 the opacity may be an issue.

## Beige Color Concentrate using TIOPREM®

**Part 1 - Matching a Color with & without TIOPREM®, then making a color concentrate.**

*(Note: It is critical to keep the total pigment weight equal for each formulation as highlighted in red)*

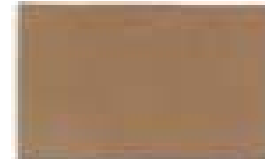
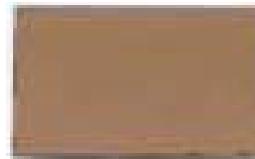
### Color ID: BEIGE

Parts per Hundred Resin (pHR) Pigment Loading = 100

<u>Pigments</u>	without TIOPREM® TiO <sub>2</sub>	with TIOPREM® TiO <sub>2</sub>
	% wt.	% wt.
Raven 14 Carbon Black	0.73	0.65
130M Red Iron Oxide	3.20	2.75
Colortherm 30	44.50	37.00
TIOPREM® BEIGE	0.00	38.00
DuPont R-350 White	<u>51.57</u>	<u>21.60</u>
	<b>100.00</b>	<b>100.00</b>

### Extrusion Formula: Linear Low Density Polyethylene (LLDPE)

<u>Raw Material</u>	without TIOPREM® TiO <sub>2</sub>		with TIOPREM® TiO <sub>2</sub>	
	pHR	%F.W.	pHR	%F.W.
LLDPE	<b>100.00</b>	48.780	<b>100.00</b>	48.780
Zinc Stearate	<b>2.00</b>	0.976	<b>2.00</b>	0.976
L-207 Wax	<b>3.00</b>	1.463	<b>3.00</b>	1.463
Raven 14 Carbon Black	<b>0.73</b>	0.3561	<b>0.65</b>	0.317
130M Red Iron Oxide	<b>3.20</b>	1.5610	<b>2.75</b>	1.341
Colortherm 30	<b>44.50</b>	21.7073	<b>37.00</b>	18.049
TIOPREM® BEIGE	<b>0.00</b>	0.000	<b>38.00</b>	18.537
DuPont R-350 White	<u><b>51.57</b></u>	<u>25.156</u>	<u><b>21.60</b></u>	<u>10.537</u>
	<b>205.00</b>	100.000	<b>205.00</b>	100.000



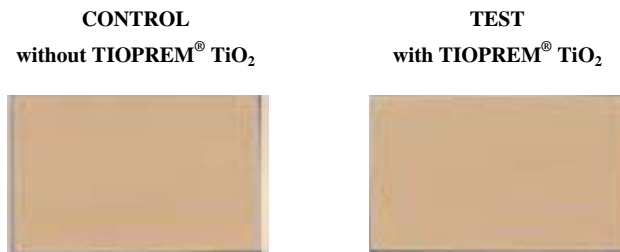
<b>CIE* Color Difference:</b>	<b>ΔL*</b>	Reference	-0.31
<b>With TIOPREM vs Without</b>	<b>Δa*</b>	Reference	-0.47
	<b>Δb*</b>	Reference	0.24
	<b>ΔE*</b>	Reference	<b>0.62</b>

## Tint Strength of Beige Color Concentrate using TIOPREM®

*Part 2 - Tinting Strength Test- The color concentrates from Part 1 are letdown with equal portions of White TiO<sub>2</sub> + Virgin Resin then the corresponding color difference is compared in order to determine tinting strength.*

**Letdown Ratio (LDR) = 25:1 (25 LLDPE: 1 part concentrate)**

**The 1 Part Concentrate = 50% White TiO<sub>2</sub>: 50% Beige Concentrate or 1:1**



	<b>L*</b>	67.13		67.23
	<b>a*</b>	9.04		8.51
	<b>b*</b>	18.64		18.17
<b>CIE* Color Difference: With TIOPREM vs Without</b>	<b>ΔL*</b>	Reference		0.1
	<b>Δa*</b>	Reference		-0.52
	<b>Δb*</b>	Reference		-0.47
	<b>ΔE*</b>	Reference		<b>0.71</b>

**CONCLUSION:** The small color difference measured indicates that the Tinting Strength of the Test Concentrate is equal to the Control Concentrate.



## Opacity of Beige Color Concentrate using TIOPREM®

*Part 3 - Opacity Test- The color concentrates from Part 1 are letdown at very high LDR's with Virgin Resin then the Opacity is determined using the spectrophotometer.*

**A. Letdown Ratio (LDR) = 100:1 (100 Parts LLDPE: 1 part concentrate)**  
*pHR pigment = 0.5*

CONTROL  
without TIOPREM® TiO<sub>2</sub>



OPACITY = 98.1

TEST  
with TIOPREM® TiO<sub>2</sub>



98

**B. Letdown Ratio (LDR) = 200:1 (200 Parts LLDPE: 1 part concentrate)**  
*pHR pigment = 0.25*

CONTROL  
without TIOPREM® TiO<sub>2</sub>



OPACITY = 93

TEST  
with TIOPREM® TiO<sub>2</sub>



88

CONCLUSION:

The Opacity of the test sample is equal to the Control @ the LDR of 100:1 but is lower @ the LDR of 200:1. These results indicate that for most applications, such as injection molding, where a typical LDR of 25:1 is used the opacity obtained will be equal; however, for those applications which require LDR's of more than 100:1 the opacity may be an issue.