

SYLOWHITE™ MB 220 Titanium Dioxide Extender

White plastic films are produced by adding a white masterbatch to the polymer resin that is normally translucent. A white masterbatch is a concentrated mix of pigments and additives in a polymer matrix and may contain up to 70% titanium dioxide (TiO₂).

TiO₂ is the leading white pigment, known for its ability to scatter visible light. Its ability to whiten and opacify is driven by three key properties:

1. High refractive index (RI)
2. Average particle size (APS) in the range of 0.2-0.3µm, enabling effective visible light diffraction
3. Dispersion – the ability to uniformly distribute the pigment in a polymer matrix

Table 1 provides the RI of several minerals used as titanium dioxide extenders compared to major polymer categories. SYLOWHITE™ MB 220 titanium dioxide extender has a RI value like major polymers, making it invisible when compounded into polymers. Unlike other minerals, its value does not vary much given its high intrinsic purity typical of a synthetically produced material. The following sections detail SYLOWHITE™ MB 220 titanium dioxide extender's features and benefits.

Dispersion

Ensuring an efficient TiO₂ dispersion is crucial to guarantee process efficiency and optimum economics. This is particularly true in the plastic film industries where optical properties are often an added value. Titanium dioxide tends to agglomerate easily due to its very small particle size and high surface/volume ratio of its primary particle. Agglomerated particles act as one single large particle resulting in a lower ability to bend visible light, leading to reduced whiteness and opacity of the plastic film and, potentially, surface imperfections and processing problems. This ultimately leads to quality problems and unnecessary costs.

See how Grace's technology may help white masterbatch producers and compounders to achieve a more efficient and cost-effective use of titanium dioxide.

	Refractive Index (RI)
Polyethylene	1.50-1.54
Polypropylene	~1.49
PET	1.58-1.64
TiO ₂ Rutile	~2.90
Kaolin	1.55-1.62
CaCO ₃	1.56-1.66
Talc	1.58-1.60
SYLOWHITE™ MB 220 titanium dioxide extender	~1.495

Table 1. Refractive index of polymers, titanium dioxide, and minerals commonly used in white masterbatch formulations

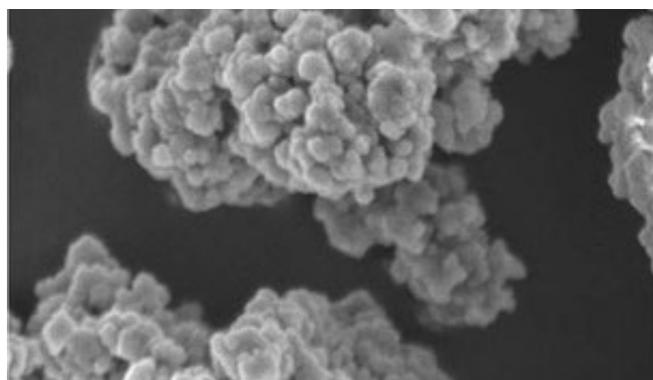


Figure 1. SYLOWHITE™ MB 220 titanium dioxide extender SEM image

SYLOWHITE™ MB 220 Titanium Dioxide Extender

SYLOWHITE™ MB 220 titanium dioxide extender is an amorphous synthetic product designed to deliver enhanced TiO₂ extender performance in plastic applications. Its controlled particle size distribution, intrinsic porosity, tridimensional structure, high purity, low b value (yellowness), and high L value (brightness) helps to reduce or eliminate the crowding effects and improve spacing. In turn, this improves light scattering resulting in higher opacity. A more efficient use of TiO₂ may help to:

1. Reduce film surface imperfections
2. Reduce white masterbatch formulation costs
3. Enhance optical properties of the plastic film or white good
4. Improve anti-blocking effect (depending upon film thickness)

White Pigments	L Value	a Value	b Value	Oil Absorption (g/100g)
TiO ₂ Rutile sample 1	99.41	-0.67	+2.36	24.8
TiO ₂ Rutile sample 2	99.12	-0.38	+1.88	14.7
TiO ₂ Rutile sample 3	94.6	-0.5	+1.7	19
TiO ₂ Rutile sample 4	94.3	-0.6	+1.9	17
SYLOWHITE™ MB 220 titanium dioxide extender	99.90	0.04	0.37	170

Table 2. Hunter L, a, b values

Case Study

In a customer case study producing a PE film of 25µm thickness, Grace investigated the possibility of replacing TiO₂ up to 15% with SYLOWHITE™ MB 220 titanium dioxide extender, resulting in a significant cost savings without adversely affecting optical film properties.

Table 3 below reports a masterbatch base case formulation and its variations at about 8% and 15% replacement of TiO₂.

	Base Case	Formula #1 TiO ₂ replacement (8%)	Formula #1 TiO ₂ replacement (15%)
Component	PMW (%)	PMW (%)	PMW (%)
PE	15%	15%	15%
TiO ₂	65%	60%	55%
Kaolin	6%	-	-
SYLOWHITE™ MB 220	-	5%	10%
Others	14%	20%	20%
TOTAL	100%	100%	100%

Table 3. White masterbatch formulation

	Base Case	Formula #1	Formula #2
L	77.77	78.70	76.20
a	-1.35	-1.33	-1.40
b	-3.58	-3.53	-3.63
Opacity (Op)	62.66	62.82	58.44

Table 4. Optical properties of the PE film based on Formula #1 and #2

Economic Balance

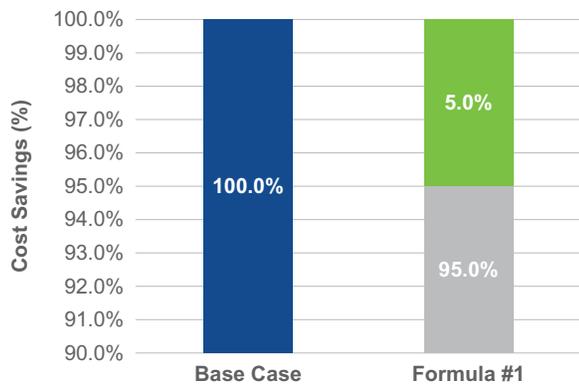


Figure 2. Cost Savings

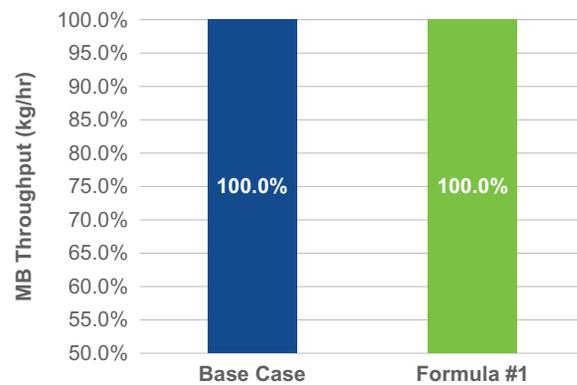


Figure 3. Extruder Throughput

More tests conducted at different PE film thickness (up to 45µm) and at a different level of titanium dioxide substitution have confirmed the results and general conclusion reported in this technical information sheet.

Results

In this case study, a Grace customer was able to replace up to 8% TiO₂ delivering:

1. No impact on final optical PE film properties
2. Improved film opacity and brightness
3. No reduction in masterbatch extrusion throughput capacity at given rate of TiO₂ substitution
4. Cost savings up to 5%

General Conclusion

SYLOWHITE™ MB 220 titanium dioxide extender offers white masterbatch producers the possibility to:

1. Replace up to a maximum of 15% in weight titanium dioxide with no or minor formulation changes to offset the increase in melt flow viscosity and general processing impact (contact Grace technical customer service to learn more)
2. Achieve cost savings up to a max of 10% depending upon rate of TiO₂ substitution
3. Achieve higher L value (brightness) and lower b value (yellowness) on final film (specific for the analyzed business case)

Ultimately, SYLOWHITE™ MB 220 titanium dioxide extender helps to deliver:

1. High level of production consistency – synthetically produced white pigment
2. Safety – no respirable crystalline silica
3. Regulatory compliance – SYLOWHITE™ MB 220 titanium dioxide extender complies with major European Food Contact and Packaging Legislations

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