CABOT

BLACK MASTERBATCHES

PLASBLAK® MASTERBATCHES
FOR AGRICULTURAL FILM APPLICATIONS

Performance and leadership in black plastics

Cabot Corporation is a global performance materials company, and we strive to be our customers' commercial partner of choice. We have been a leading manufacturer of carbon black and other specialty chemicals for more than 130 years, and we have supplied masterbatches and compounds to the plastics industry for more than 50 years.

Our global reach enables us to work closely with customers to meet the highest standards for performance, quality and service. We have production facilities in each region of the globe, along with three applications development centers that are closely linked to provide customers with global service as well as our latest innovations.

Global reach

We support customers around the world in our global production and applications development centers

- **North America**
  - Canada
  - Mexico
  - United States
- **South America**
  - Argentina
  - Brazil
  - Colombia
- **Europe, Middle East & Africa**
  - Belgium
  - Czech Republic
  - France
  - Germany
  - Italy
  - Latvia
  - Norway
  - Switzerland
  - The Netherlands
  - United Arab Emirates
  - United Kingdom
- **Asia Pacific**
  - China
  - India
  - Indonesia
  - Japan
  - Korea
  - Malaysia
  - Singapore

With approximately 4,500 employees worldwide, we continue to create a diverse environment rooted in values and sustainability.

We operate 45 manufacturing sites in 21 countries, all with local management teams. We have a global footprint in order to serve our customers throughout the world.

Delivering opacity and weathering performance for agricultural film applications

We offer a wide range of black masterbatch products that deliver exceptional opacity and weathering performance, as well as favorable mechanical properties, for mulch and silage agricultural films. Our portfolio includes products that are compatible with a broad array of polymers, co-polymers and recycled polymers used in agricultural films. These products combine carefully selected specialty carbon blacks, additive packages and carrier systems that are mixed using state-of-the-art masterbatch technology. As a result, we can provide masterbatches that are tailored to provide highly efficient and cost-effective opacity, weathering and mechanical performance.

Our PLASBLAK® brand

We supply a diverse product range of black masterbatch products to meet performance and processability requirements across many industries and end uses. These products are sold under our long-established PLASBLAK® brand that is synonymous with quality, reliability, and high performance.

While our PLASBLAK products have performed successfully in plastic applications for decades and are to be top choices for customers, we are always innovating to improve our formulations and develop new products to meet the plastics industry's evolving requirements.

Products for agricultural film applications

In most agricultural film applications, the critical design parameters include:

- Opacity performance
- Weathering resistance
- Mechanical properties, including tensile and impact strength and tear and puncture resistance
- Tack properties (for silage stretch wrap film for bales)

We have designed the products below to provide these performance attributes. For more information regarding product performance and application information, please refer to the later sections of this brochure.

Masterbatches for mulch film

Mulch films are plastic films that are laid at ground level around crops to suppress weed growth, maintain humidity, and protect roots from climatic extremes. For these films, we offer the following products:

PLASBLAK® masterbatch	Carbon black content (wt%)	Masterbatch description
PE2642	40%	Premium masterbatch with outstanding opacity and weathering performance
PE2640	40%	Masterbatch used where strong opacity and weathering performance is desired
PE2824	-	Standard masterbatch for mulch films where a balance of properties is desired
PE2272	50%	Standard masterbatch offering balanced performance where carbon black levels are specified
PE1851	50%	Masterbatch offering basic performance where carbon black levels are specified
PE2605	50%	Economy masterbatch where performance levels are not as stringent

Masterbatches for silage stretch wrap

Silage stretch wrap films are used by farmers to wrap crop bales to produce nutritional winter feed for livestock through anaerobic fermentation. For these films, we offer the following products:

PLASBLAK® masterbatch	Carbon black content (wt%)	Masterbatch description
LL4897	40%	Premium masterbatch with excellent carbon black dispersion for outstanding opacity and weathering performance and good film quality
PE4780	40%	Standard masterbatch for silage stretch wrap

Masterbatches for silage sheet and bags

Silage sheet and bags are similarly used by farmers to produce silage, but sheet and bags are of a greater thickness than stretch wrap films. For silage sheet and bag applications, we offer the following products:

PLASBLAK® masterbatch	Carbon black content (wt%)	Masterbatch description
PE2642	40%	Premium masterbatch with outstanding opacity and weathering performance, particularly for co-extrusion applications
PE2640	40%	Standard masterbatch where a balance of properties is desired
PE2824	-	Standard masterbatch offering balanced performance
PE2272	50%	Masterbatch offering basic performance where carbon black levels are specified.

Mulch film product performance

Mulch film application background

Mulch film is plastic film that is laid loosely at ground level around crops to suppress weed growth, maintain humidity, and protect roots from climatic extremes. Mulch films allow for improved crop yield with the following advantages:

- Increased soil temperature and humidity
- Increased root growth
- Increased germination rates
- Reduced labor requirements
- Reduced chemical requirements for plant protection

Mulch films are generally based on LDPE, LLDPE, or a blend of these two polymers, and they can vary in thickness from 10 to 80 µm depending on the target crop and required service life. Black mulch films are used primarily for weed control, as black films block most light from reaching underlying soil and thus prevent weed growth. Mulch films can be divided into three main categories, as shown in Table 1. Using high quality black masterbatches are critical for ensuring performance requirements are met.

For black mulch films, the key performance requirements are

- Opacity (for weed control)
- Weathering performance to meet service life requirements
- Preservation of polymer mechanical properties to ensure performance over its service life

Table 1: Mulch film categories

Characteristic	Mulch film categories		
	Standard	Premium	Special
Thickness	30-40 µm	60-80 µm	10-50 µm
Expected service life	1 season	up to 5 years	up to 3 years
Applications	Fruits and vegetables	Vines and amenity plants	Specialist crops or for extended life

Mulch film opacity

In order to prevent weed growth, mulch films must have sufficient opacity. Opacity requirements for different films are defined in the European Standard EN13655, and since 2003, the specifications correspond to light transmission of 1 lux for films below 20 µm thickness and 0.1 lux for films of 20 µm thickness and above.

The masterbatch loadings required to achieve 1 and 0.1 lux light transmission vary by masterbatch and are summarized in Tables 2 and 3, respectively.

Table 2: Approximate MB loading (% weight) to achieve 1 lux light transmission

PLASBLAK product	LDPE/LLDPE film thickness (µm)					
	15	30	40	50	60	80
PE2642	20	10	7	6	5	4
PE2640	20	10	8	6	5	4
PE2824	31	16	12	9	8	6
PE2272	21	11	8	6	5	4
PE1851	21	11	8	6	5	4
PE2605	22	11	8	7	6	4

Table 3: Approximate MB loading (% weight) to achieve 0.1 lux light transmission

PLASBLAK product	LDPE/LLDPE film thickness (µm)				
	30	40	50	60	80
PE2642	12	9	7	6	4
PE2640	12	9	7	6	5
PE2824	19	14	11	9	7
PE2272	13	10	8	6	5
PE1851	13	10	8	6	5
PE2605	13	10	8	7	5

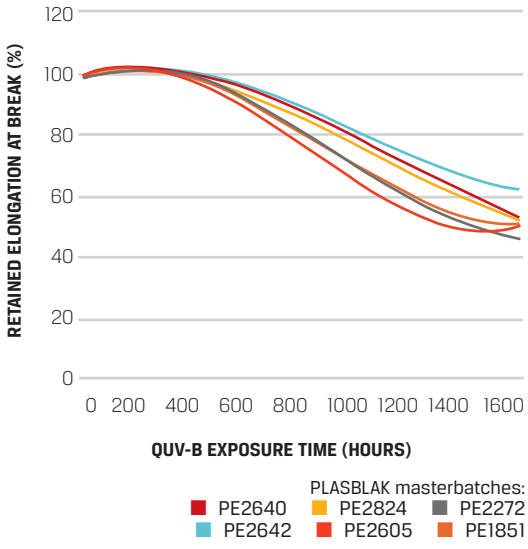
Mulch film weathering resistance

In addition to specifying opacity requirements, European Standard EN13655 establishes weathering resistance specifications. Mulch films are required to have durability levels that match or exceed expected service life. To meet these standards, most compounders utilize carbon black masterbatches because carbon black is among the most effective absorbers of ultraviolet (UV) light that can damage polymers.

For thin films and films designed for long service lives, we use premium specialty carbon blacks designed to provide outstanding UV protection. In some cases, the additional use of an antioxidant package is desirable to prevent polymer degradation during processing of mulch film.

Weathering data for 30 µm films with appropriate black masterbatch loading to achieve 0.1 lux light transmission are shown in Figure 1.

Figure 1: Weathering performance of 30 µm LDPE/LLDPE films incorporating PLASBLAK masterbatches to achieve 0.1 lux light transmission



Mulch film mechanical properties

Maintenance of polymer mechanical properties is an important consideration when choosing a black masterbatch for mulch films. Mulch films must remain physically intact during use, resist damage during crop planting and withstand physical disruption due to extreme weather or puncture from birds and other animals.

Impact strength

Dart drop impact strength is a measure of the puncture resistance of a film. Figure 2 illustrates dart drop impact strength of 30 µm films made with LDPE/LLDPE compounds loaded with our masterbatches to achieve 0.1 lux light transmission.

Tensile strength

Tensile strength is a measure used to quantify a film's ability to resist tearing and other mechanical stresses. Tensile strength and percent elongation at break of 30 µm films made with LDPE/LLDPE compounds incorporating our masterbatches at loadings to achieve 0.1 lux light transmission are shown in Figures 3 and 4, respectively.

Figure 2: Dart drop impact strength of 30µm LDPE/LLDPE films incorporating PLASBLAK masterbatches to achieve 0.1 lux light transmission

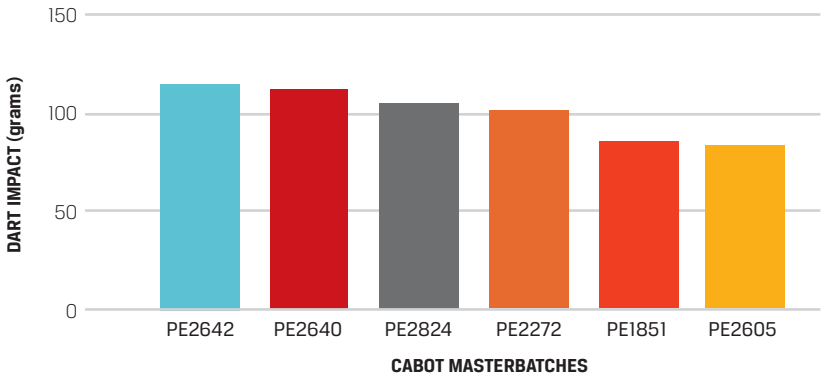


Figure 3: Tensile strength of 30 um LDPE/LLDPE films incorporating PLASBLAK masterbatches to achieve 0.1 lux light transmission

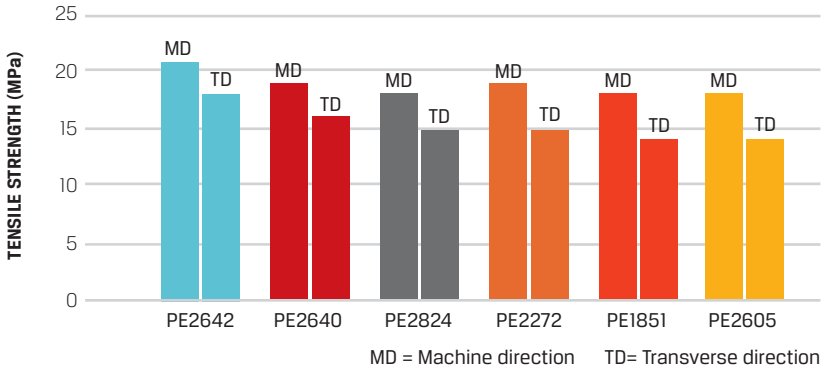
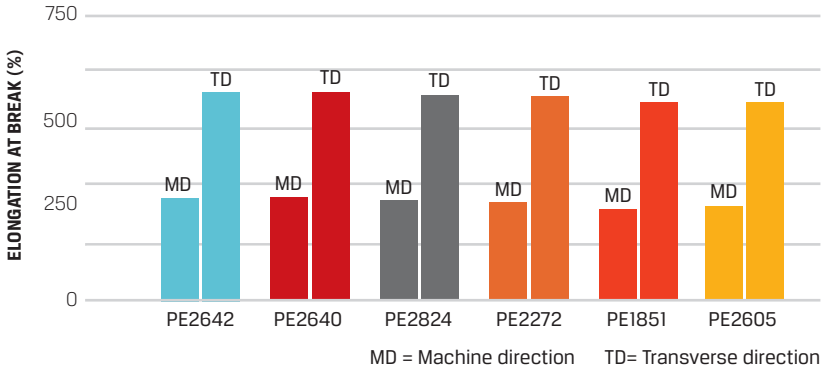


Figure 4: Elongation at break of 30µm LDPE/LLDPE films incorporating PLASBLAK masterbatchess to achieve 0.1 lux light transmission



Silage film product performance

Silage film application background

Silage film is used by farmers to produce silage – nutritional winter feed derived from anaerobic fermentation of grasses and other crops. Silage is normally produced during spring and late summer in temperate climates and during the rainy season in tropical climates. The process of anaerobic fermentation is designed to preserve green fodder, such as maize and grass and other agricultural produce in a moist state to maximize its nutritional value without creating harmful by-products of aerobic fermentation.

Silage films can be produced in three forms, as outlined in Table 4. Key performance characteristics of all forms of silage films are:

- A certain degree of opacity
- Excellent weathering resistance to preserve mechanical and gas barrier properties of films throughout the duration of films' outdoor exposure
- Excellent puncture and tear resistance to maintain low oxygen permeability
- Excellent tack and one-side cling properties (for bale wrap)

Table 4: Silage film categories

Characteristic	Silage film category		
	Stretch wrap for bales	Silage sheet	Silage bags
Thickness	15-25 µm	125-200 µm	90-150 µm
Color	Black, white, or green mono- or co-extruded	Black, white, or black/white co-extruded	Black or white
Polymers	LLDPE and/or metallocene blends	Recycled PE, LDPE, LLDPE or EVA/EBA. Produced in large widths	Recycled PE, LDPE, LLDPE, or EVA/EBA

Silage stretch wrap opacity

High levels of opacity are desirable in silage stretch wrap film, particularly for single layer wraps. Table 5 details light transmission levels though 15µm and 25µm films loaded with PLASBLAK masterbatches at typical loading levels.

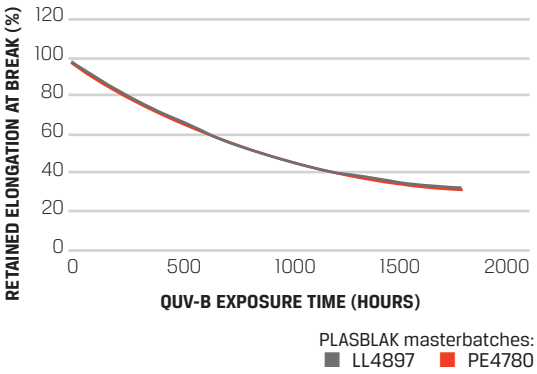
Table 5: Light transmission (lux) through LDPE films Loaded with PLASBLAK master-batches (incident light = 100,000 lux)

PLASBLAK MB loading (6 weight %)	Film thickness	
	15 µm	25 µm
LL4897	2010	149
PE4780	1818	126

Silage stretch wrap weathering

Weathering performance requirements are dependent on promised film service life and ambient climate conditions. Expected film lifetimes are typically a minimum of 12 months. Comparative weathering resistance performance for our silage stretch wrap PLASBLAK masterbatches at typical addition rates is shown in Figure 5.

Figure 5: Weathering Performance of 25 µm LDPE films incorporating PLASBLAK masterbatches at typical (6 weight %) loadings (test methods ISO4892, ISO527-3)



Silage stretch wrap mechanical properties

Silage stretch wrap films need to withstand the baling process and use in the field without puncturing or tearing. If they do become punctured or torn, oxygen can infiltrate the silage and cause spoilage. Impact, tensile, and elongation at break data for 25µm LDPE films containing our masterbatches for silage stretch wrap at typical loadings are shown in Figures 6, 7 and 8, respectively.

Figure 6: Impact strength of 25µm LDPE films incorporating PLASBLAK masterbatches at typical (6 weight %) loadings

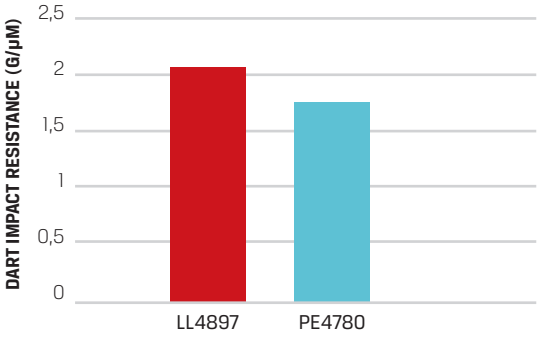


Figure 7: Tensile strength of 25µm LDPE films incorporating PLASBLAK masterbatches at typical (6 weight %) loadings

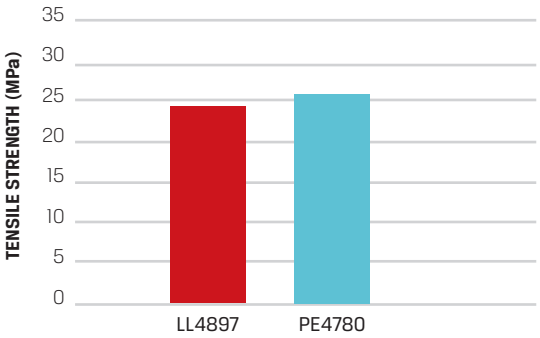
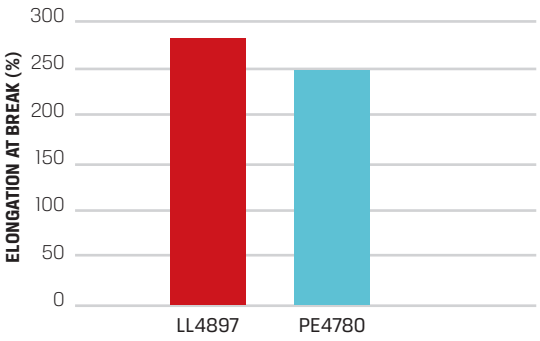


Figure 8: Elongation at break of 25µm LDPE films incorporating PLASBLAK masterbatches at typical (6 weight %) loadings



Figures 6 -8:
PLASBLAK masterbatches:
LL4897 PE4780

Silage stretch wrap tack properties

Tack properties of silage stretch wrap film are normally achieved by the use of polyisobutylene (PIB) which can be combined with other tackifier additives such as ethylene vinyl acetate (EVA), very low density polyethylene (VLDPE), atactic polypropylene (a-PP) or metallocenes. The final tack properties of a film are affected by many factors including the extrusion technique, film thickness, film structure, cooling rate, blow-up ratio and others. In order to determine whether the pigment type also has an influence in the tack properties in colored films, we ran a study under controlled conditions incorporating two types of PIB and a number of very different carbon black products.

Within the scope of this study, it was concluded that the type and level of carbon black present in silage stretch wrap film did not influence the tack performance of the film given by PIB. The biggest influence on tack performance was the molecular weight of the PIB used. A higher molecular weight PIB appeared to provide better tack performance.

For optimal masterbatch dilution, our experience is that the most effective way to introduce PIB to the extruder is after the black masterbatch and polymer have melted and been well-mixed, or homogenized, so that the carbon black is well-dispersed prior to viscosity reduction due to the introduction of PIB.

For further information on the influence of black masterbatches on the tack performance of PIB-containing silage stretch wrap films, please contact your Cabot representative

Silage sheet and bag product performance

Due to the higher thicknesses, achieving the required opacity, weathering and mechanical properties is relatively easy to achieve for silage sheet and bags compared to silage stretch wrap film. The required performance can typically be achieved with our standard masterbatches as long as sufficient black masterbatch is added to reach the required UV protection.

Product data

PLASBLAK masterbatch product	Description
PE2642	Premium masterbatch for excellent opacity and weathering performance
PE2640	Masterbatch for premium opacifying and strong weathering performance
PE2824	Standard masterbatch for mulch films, silage sheet & bags
PE2272	Standard masterbatch for specified carbon black content
PE1851	Economy masterbatch for specified carbon black content
PE2605	Low-cost masterbatch that is an alternative to PE1851
LL4897	Premium masterbatch for silage stretch wrap
PE4780	Standard masterbatch based on LDPE, for silage stretch wrap

Note: All listed PLASBLAK masterbatches are compatible with LDPE, LLDPE and HDPE and they are moderately compatible with PP.

Agricultural film applications			Properties		
Mulch film	Silage stretch wrap	Silage sheet and bags	Carbon black loading (wt %)	Typical MFI (g/10 min)	MFI conditions
•			40 %	20	190° C/ 21.6 kg
•		•	40 %	24	190° C/ 21.6 kg
•		•		40	190° C/ 21.6 kg
•		•	50 %	7	190° C/ 10.0 kg
•		•	50 %	19	190° C/ 21.6 kg
•		•	50 %	22	190° C/ 21.6 kg
	•		40 %	7	190° C/ 10.0 kg
	•		40 %	11	190° C/ 10.0 kg

The data in the table above are typical test values intended as guidance only, and are not product specifications.
Product specifications are available from your Cabot representative.

Additional references

This Product Application Guide provides specific information about our PLASBLAK black masterbatches for use in agricultural film applications. For other application-specific product information and broader product portfolio information, please visit cabotcorp.com or contact your Cabot representative.

NORTH AMERICA
Cabot Plastics Canada
707 Pierre Tremblay Boulevard
Saint-Jean-sur-Richelieu
QC, J2X 5G5
Canada
T +1 450 347 4371
F +1 450 347 9936

SOUTH AMERICA
Cabot Brasil Industria
e Comericio Ltda.
Rua do Paraiso 148 - 5 andar
04103-000 Sao Paolo,
Brazil
T +55 11 2144 6400
F +55 11 3253 0051

EUROPE
Cabot Specialty Chemicals
Coordination Center
SIA Cabot Latvia
101 Mukusalas Street
Riga, LV-1004, Latvia
T +371 6705 0700
F +371 6705 0985

MIDDLE EAST & AFRICA
Cabot Dubai
P.O. Box 17894
Jebel Ali Free Zone
LOB 15, Office 424
Dubai
United Arab Emirates
T +371 6705 0700
F +371 6705 0985

ASIA PACIFIC
Cabot China Ltd.
558 Shuangbai Road
Shanghai 201108
China
T +86 21 5175 8800
F +86 21 6434 5532

JAPAN
Cabot Specialty Chemicals Inc.
Sumitomo Shiba-Daimon Bldg. 3F
2-5-5 Shiba Daimon,
Minato-ku
Tokyo 105-0012
Japan
T +81 3 6820 0255
F +81 3 5425 4500

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cabotcorp.com

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