

MASTERBATCHES



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## **Black Masterbatch Application and Selection Guide for Agricultural Film**



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# Introduction

This Selection Guide provides detailed information about our extensive range of black masterbatches specifically designed for use in agricultural films.

The brochure provides performance information on each masterbatch with regard to important application parameters such as opacity, weathering resistance, tensile strength, puncture resistance, tack properties and chemical resistance.

It also provides information on the requirements of end users, industry test standards and other matters relevant to the production and use of agricultural film.



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# Mulch Film

## ■ Definition

Mulch film is loose film laid at ground level around crops to suppress weed growth, maintain humidity and protect roots from climatic extremes.

The end result is a much improved crop yield with the following advantages:

- Increased soil temperature and humidity
- More roots
- Labour saving
- Fewer chemicals required for plant protection
- Higher germination rates

Mulch films are laid on an enormous area of land world-wide, totalling about 4 million hectares.

Mulch films are generally based on LDPE, LLDPE or a blend and vary in thickness from 10 to 80 microns depending on the crop and the required service life. They are mainly transparent or black, but can also be white, black/white or coloured (mainly to attract or repel certain insects).

Transparent films transmit most of the solar radiation to the soil. As this solar energy is absorbed by the soil and converted into heat, the result is a much quicker heating up of the soil than for pigmented mulch films. These types of film do not prevent weed growth.

Mulch film can be divided into 3 main categories:

### **Standard**

- 30 – 40 microns
- one season service life
- fruit and vegetables

### **Premium**

- 60 – 80 microns
- up to 5 year's service life
- vines and amenity plants

### **Special**

- 15 – 50 microns
- up to 3 year's service life
- specialist crops or for extended life

For black mulch films, the key performance requirements are the following:

- opacity (for weed control)
- weathering resistance appropriate to the service life
- mechanical properties



Cabot's range of black masterbatches provides the technical performance demanded by the film producer via a number of options. This is achieved by selection of the appropriate carbon black, additives and carrier systems together with use of state-of-the-art mixing technology.

Cabot's recommended PLASBLAK® masterbatches for mulch film are as follows:

Grade	Formulation	Mulch film
PE2642	40% small particle size carbon black	Premium grade with excellent opacity and weathering performance
PE2640	40% small particle size carbon black	Premium opacifying grade
PE2824	Small particle size carbon black	Standard grade
PE2272/ PE2272R	50% standard carbon black	Standard grade for specified carbon black content
PE1851	50% standard carbon black	Economy grade for specified carbon black content
PE2605	50% standard carbon black	Low cost alternative to PE1851

### ■ Opacity

In order to ensure that weed growth does not occur, it is necessary for the film to have sufficient opacity. The opacity requirements for different films are defined in the European Standard EN13655, and currently correspond to a 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 addition rates (%) required to achieve 1 Lux light transmission vary according to the masterbatch selected and are given in Table 1.

The masterbatch addition rates (%) required to achieve 0.1 Lux light transmission are shown in Table 2.

Table 1: MB addition rate (%) to achieve 1 Lux light transmission

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/PE2272R	21	11	8	6	5	4
PE1851	21	11	8	6	5	4
PE2605	22	11	8	7	6	4

Table 2: MB addition rate (%) to achieve 0.1 Lux light transmission

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/PE2272R	13	10	8	6	5
PE1851	13	10	8	6	5
PE2605	13	10	8	7	5

■ **Weathering resistance**

Mulch film is required to have a durability to match its service life. As previously mentioned, a weathering test is included in the EN13655 Standard. This is achieved, in the case of black films, by the use of carbon black masterbatches.

For thinner films and films requiring longer service life, a small particle size weathering grade of carbon black is selected and, in some cases, the use of an antioxidant package is highly desirable to prevent degradation from occurring during processing as this can adversely affect weathering performance.

QUV weathering data for 30µm film using addition rates of masterbatch to achieve 0.1 Lux light transmission is given in Fig. 1.

■ **Mechanical properties**

Mechanical properties are another important consideration when choosing a masterbatch for mulch film. The film must remain intact during use, resisting damage during planting of the crops and environmental factors such as high winds, birds or animals.

Dart drop impact strength is a measure of the puncture resistance of the film. Fig. 2 shows dart drop impact strength using addition rates of masterbatch to achieve 0.1 Lux light transmission in 30µm LDPE/LLDPE film.

Fig. 1: QUV-B weathering of 30 µm LDPE/LLDPE film

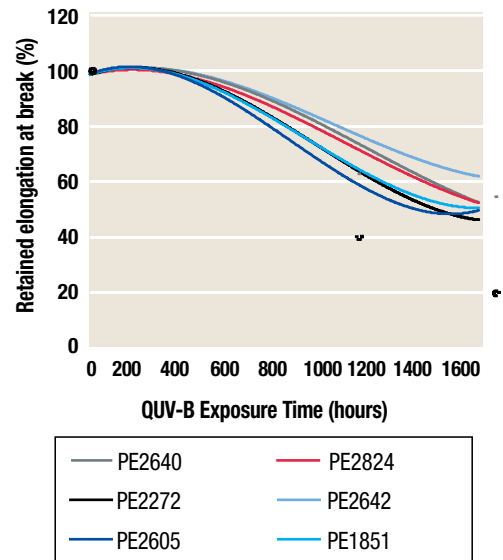
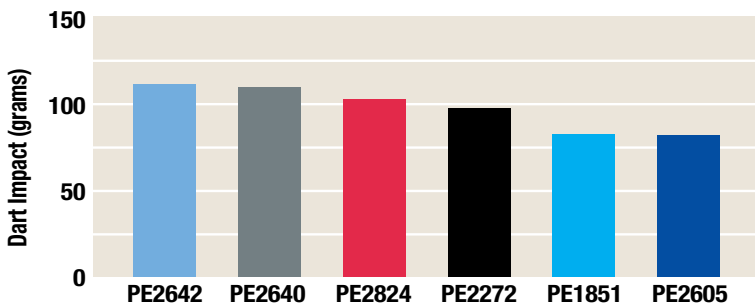


Fig. 2: Dart drop impact strength of 30µm LDPE/LLDPE film



Tensile properties are also an important measure of the resistance of the film to tearing and other mechanical stresses. Figs. 3 and 4 show the tensile strength and elongation at break using addition rates of masterbatch to achieve 0.1 Lux light transmission in 30µm LDPE/LLDPE film.

Fig. 3: Tensile strength of 30 µm LDPE/LLDPE film - Machine Direction (md) & Transverse Direction (td)

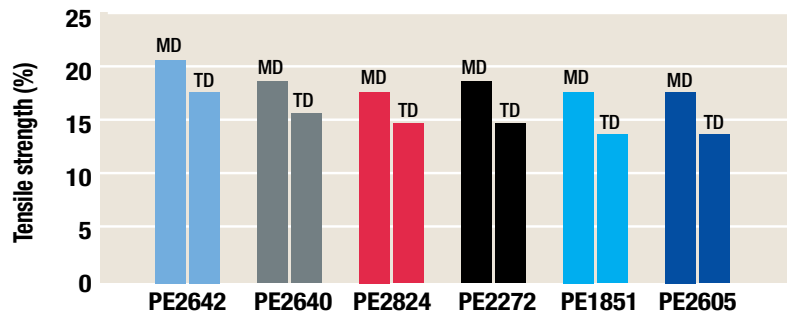
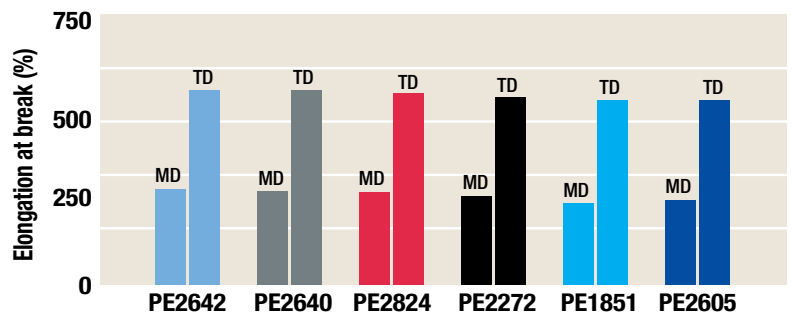


Fig. 4: Elongation at break of 30 µm LDPE/LLDPE film - Machine Direction (md) & Transverse Direction (td)



# Silage Film

## ■ Definition

Silage film is used by farmers to produce nutritional winter feed for livestock by anaerobic fermentation.

Silage is the process by which fodder is produced and stored. It is normally produced during spring and late summer in temperate climates and in the rainy season in the tropics. 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 maximise its nutritional value without harmful formation of fermentation by-products.

The mechanism is as follows:

### **Respiration activity (plants)**

- Degradation of sugars, heat production
- Loss in nutrient value

### **Acidification**

- Coli bacteria  
Acid (mainly lactic) formation, decrease in pH  
Active to pH 4.5
- Lactic bacteria  
Continuing lactic acid formation  
Stabilisation at pH 3.5 – 4.2

### **Undesirable fermentation**

- Fodder putrefaction (butyric and rot inducing bacteria)

Silage films can be produced in one of 3 forms:

### **Silage stretch wrap for bales**

- 15 – 25 microns
- black, white or green mono- or co-extruded
- produced from LLDPE and /or metallocene blends

### **Silage sheet**

- 125 – 200 microns
- black, white or black/white co-extruded
- produced in large widths from recycled polyethylene, LDPE, LLDPE or EVA/EBA

### **Silage bags**

- 90 – 150 microns
- black or white
- produced from recycled polyethylene, LDPE, LLDPE or EVA/EBA

The key characteristics of a good silage film are:

- A certain degree of opacity
- Excellent weathering resistance to preserve the original mechanical and gas barrier properties thus ensuring the protective role of the film throughout the duration of its outdoor exposure
- Excellent puncture and tear resistance to ensure low oxygen permeability
- Excellent tack and one side cling properties (for bale wrap)





## Silage Stretch Wrap for Bales

Cabot's range of black masterbatches offers the required properties by careful selection of fine particle size carbon blacks and a thermal stabilisation package to give excellent dispersion and weathering performance.

Cabot's recommended PLASBLAK masterbatches for silage stretch wrap are the following:

Grade	Formulation	Silage stretch wrap
PE4441	38% small particle size carbon black + antioxidant	Premium grade with high dispersion quality
LL4897	39% small particle size carbon black + antioxidant	Standard grade
PE4780	40% small particle size carbon black + antioxidant	Standard grade based on LDPE

Table 3:

Film thickness	15 µm	25 µm
6.5% PE4441	3330 Lux	345 Lux
6.0% LL4897	2010 Lux	149 Lux
6.0% PE4780	1818 Lux	126 Lux

### ■ Opacity

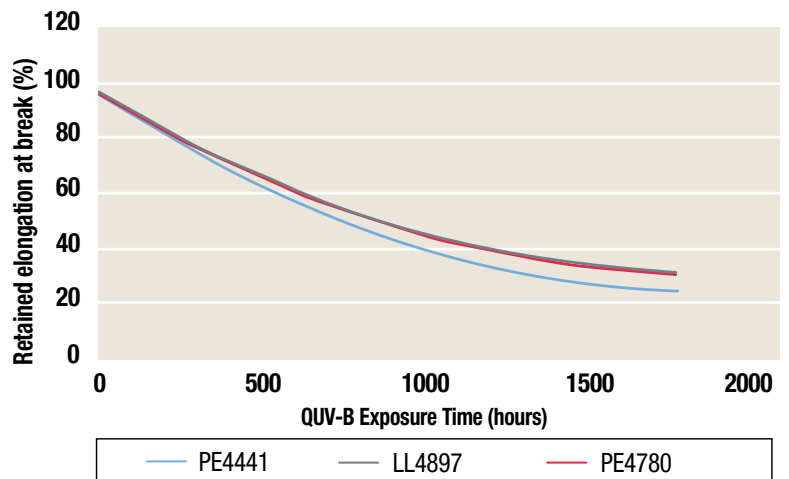
High levels of opacity are desirable in silage stretch wrap film although it is not essential for the film to be totally opaque since film is normally wrapped 3 or 4 times around each bale. Table 3 shows the level of light transmission through 15µm and 25µm films containing CABOT's PLASBLAK silage stretch wrap grades used at the recommended addition levels. The incident light is 100,000 Lux.

### ■ Weathering

Excellent weathering resistance appropriate to the service life of the film and region in which the film is to be used, is an essential requisite of silage stretch wrap film. The lifetime would usually be expected to be a minimum of 12 months. Black silage bales are normally used in the UK, Ireland, Scandinavia, France and Spain. For the latter 2 regions, it is recommended to use a UV stabiliser masterbatch in conjunction with one of the PLASBLAK masterbatches.

Comparative QUV weathering performance for Cabot's silage stretch wrap PLASBLAK masterbatches at their recommended addition rates is shown in Fig. 5:

Fig. 5: QUV-B weathering of 25 µm black LDPE films ISO 4892 and ISO 527-3



## ■ Mechanical properties

Silage stretch wrap films need to withstand the baling process and use in the field without puncturing or tearing, otherwise oxygen will be present in the fermentation process causing spoilage of the crop.

Tensile strength, elongation at break and dart drop impact strength tests have been carried out on films produced using Cabot's silage stretch wrap PLASBLAK masterbatches at their recommended addition rates in 25µm LDPE film as follows:

Fig. 6: Tensile strength of 25 µm black LDPE films

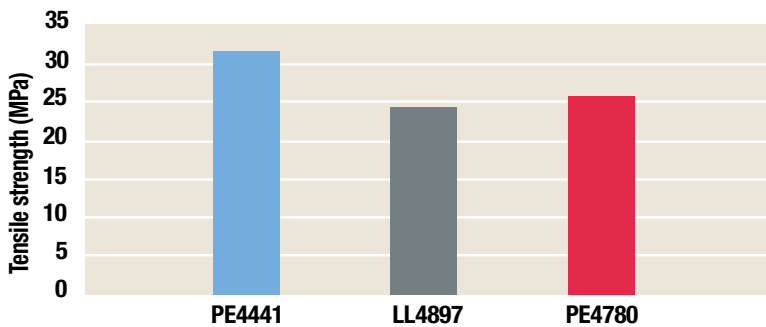


Fig. 7: Elongation at break of 25 µm black LDPE films

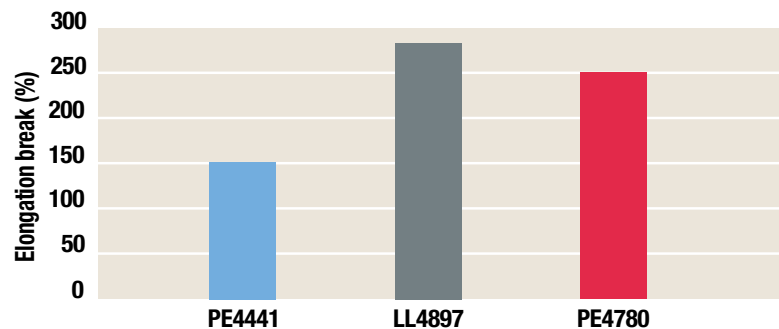
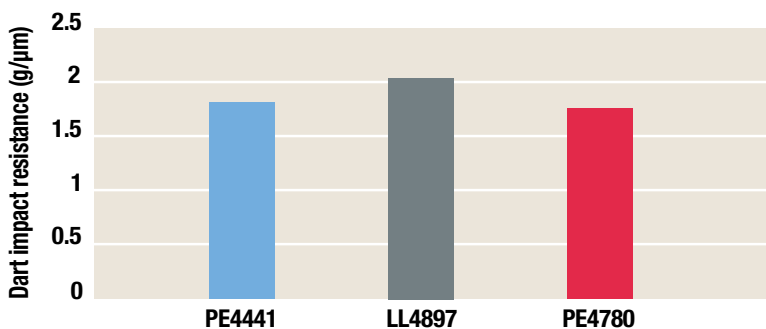


Fig. 8: Dart impact resistance of 25 µm black LDPE films



### ■ 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 the film are affected by many factors including the extrusion technique, film thickness, film structure, cooling rate, blow-up ratio and so on. In order to determine whether, in coloured films, the pigment type also has an influence, Cabot made a study of the tack properties of black films produced under controlled conditions incorporating 2 types of PIB and a number of very different grades of carbon black.

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 was found to be that due to the molecular weight of the PIB used. A higher molecular weight PIB should be chosen if greater tack performance is required.

For optimum masterbatch dilution, it is recommended that PIB is pumped into the extruder after the masterbatch and polymer have melted and are well mixed or homogenised in order to allow efficient mixing before the viscosity is greatly reduced due to the presence of the PIB.

Further information can be found in the Cabot Technical Tool “Influence of Black Masterbatches on the Tack Performance of PIB Used in Silage Stretchwrap Films”, which can be obtained from your Cabot representative.



## Silage Sheet and Silage Bags

Cabot's recommended PLASBLAK masterbatches for silage sheet and silage bags are the following:

Grade	Formulation	Sheet and silage bags
PE2642	40% small particle size carbon black	Premium opacifying weathering grade
PE4780	40% small particle size carbon black	Premium weathering grade
PE2640	40% small particle size carbon black	Premium grade for co-extrusion applications
PE2824	35% small particle size carbon black	Standard grade
PE2605	50% standard carbon black	Cost effective grade for specified carbon black content
PE1851	50% standard carbon black	Standard grade for specified carbon black content

### ■ Opacity

Highly opaque film is desirable for silage sheet and silage bags. However this is relatively easy to achieve since the film is of a greater thickness than silage stretch wrap film and the minimum masterbatch addition level to give the desired weathering performance will almost certainly be more than enough to give the film sufficient opacity.

### ■ Weathering

Weathering resistance of silage sheet and silage bags is easier to achieve than that of silage stretch wrap film, the films being of a thicker gauge. Masterbatches of a lower weathering performance quality can be used provided that masterbatch is added to ensure sufficient carbon black to give the required weathering protection (normally a minimum of 2% carbon black).

### ■ Mechanical properties

Silage sheet and bags need to have adequate mechanical properties to be able to be used in the field without puncturing or tearing, otherwise oxygen will be present in the fermentation process causing spoilage of the crop. Again, this is easier to achieve as the thickness of the films already ensures a reasonable level of mechanical performance.



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