



SPECIALTY CARBON BLACKS

SPECIALTY CARBON BLACKS FOR PLASTIC PRESSURE PIPE





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 additives to the plastics industry since its inception.

Our global reach enables us to work closely with customers to meet the highest standards for performance, quality and service. Our global production network and three applications development facilities provide our customers with global service capabilities as well as the latest technical 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 44 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 product performance through premium UV protection

For the plastic pressure pipe industry, we are the leader in the development of high purity specialty carbon blacks defined as "p-types" that, when compounded using internationally recognized compounding techniques, can meet ISO and other national standards governing the production and installation of HDPE pressure pipe. Our p-type carbon blacks provide exceptional ultraviolet (UV) weathering and low compound moisture absorption (CMA) with extremely low levels of sulfur, ash and grit ensuring best-in-class performance in regulated pressure pipes.

Our brands

We supply a diverse product range of specialty carbon black products to meet performance and processability requirements across many industries and end uses. Offered in pellet and powder form, our long-established products for plastics include VULCAN[®], ELFT[®] and BLACK PEARLS[®] specialty carbon blacks. While our products have performed successfully in plastic applications for more than 50 years and are top choices for the industry, we continue to innovate and develop new products to drive our customers' product performance.

Product recommendations for pressure pipe applications

Specialty carbon blacks provide the necessary UV protection to prevent polymer degradation and extend the performance life of plastic pressure pipes that are typically used for up to 50 years or more. National standards based on ISO4427, ISO4437, EN12201 and other international regulations require the use of high quality material in the production of PE pressure pipe. Selecting the right carbon black is critical to satisfying these requirements and the carbon black should have the following characteristics:

- ♦ Small primary particle size (typically less than 25 nm) for superior UV protection
- ♦ Extremely low levels of sulfur for better organoleptics (critical for water pipe)
- ♦ Low levels of ash and grit to prevent premature pipe failure

By definition, p-type specialty carbon blacks meet these requirements – both ELFTEX® TP and ELFTEX P100 specialty carbon blacks are our leading p-type products. The quality of the fully formulated pipe compound also depends on how well the p-type carbon black is incorporated into the polymer. Both ELFTEX TP and ELFTEX P100 specialty carbon blacks provide compounders with superior dispersibility, which leads to high levels of dispersion in finished products and excellent CMA performance. The relative performance of these recommended products is shown in Figure 1.

Product performance

Our ELFTEX TP and ELFTEX P100 p-type specialty carbon blacks provide the necessary UV protection to prevent polymer degradation and extend the performance life of plastic pressure pipe. In addition, these carbon blacks are easily incorporated into compounds, which is critical for achievement of optimal pipe performance. Some of the performance advantages of our specialty p-type carbon blacks include:

- ◆ UV protection
- ◆ Dispersibility
- ◆ Physical and chemical cleanliness
- ◆ Low CMA

UV protection / weatherability

Exposure to sunlight leads to the degradation of plastic materials, and in pipe applications, this can cause failure after installation. The strong absorption characteristics and high opacity performance of carbon black make it one of the most efficient and widespread additives used for UV absorption to protect polymer integrity.

Particle size is correlated to UV performance as illustrated in Figure 2; both ELFTEX TP and ELFTEX P100 specialty carbon blacks have particle size <25 nm, providing exceptional UV performance.

Figure 3 illustrates the increasing protection with increased loading. As a result, ISO and other national standards have codified particle size and carbon black loadings.

Figure 1:
Carbon blacks for pressure pipe

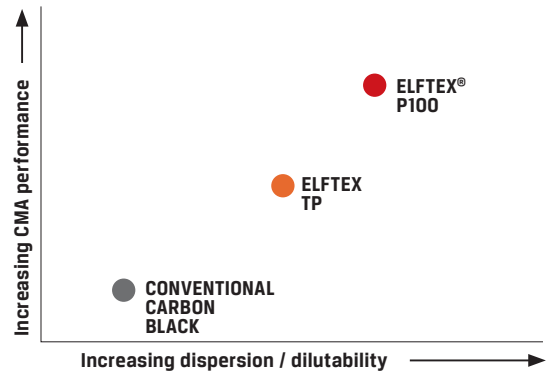


Figure 2:
Effect of primary particle size on weathering performance

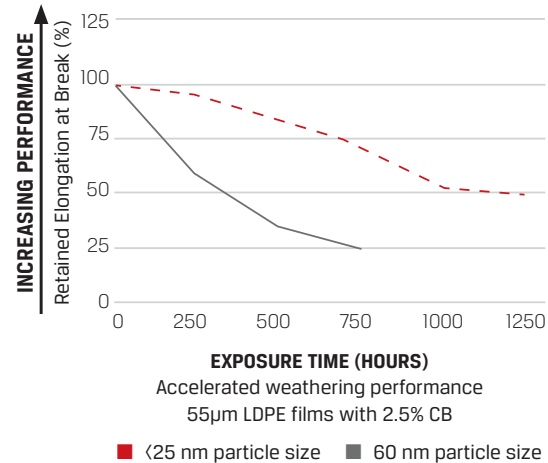
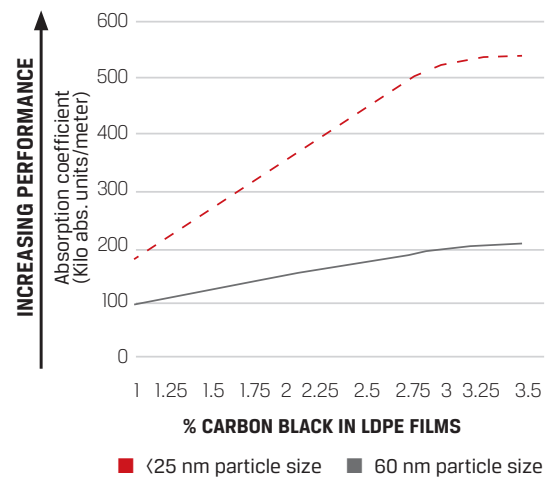


Figure 3:
Effect of loading levels on ultraviolet light absorption



Dispersibility

Good dispersibility is critical to achieve important plastic pressure pipe attributes and benefits, including:

- ♦ Optimum UV protection
- ♦ Surface smoothness for favorable fluid flow characteristics
- ♦ Retention of mechanical properties of the base polymer
- ♦ Improved yields in compounding equipment

These characteristics are related to the carbon black dispersion, a measure of the level to which carbon black aggregates are evenly distributed in the compound. As shown in Figure 4, poor dispersion leads to only partial de-agglomeration of aggregates, which can cause surface and mechanical defects. In contrast, excellent dispersion achieves full de-agglomeration and ensures a homogeneous distribution of carbon black within the polymer matrix.

Most industry standards (e.g., ISO11420, ISO18553 and NFT51-142) recognize the importance of dispersion quality and specify a microscopic dispersion rating of <3. As shown in Figure 5, both ELFTEX® P100 and ELFTEX TP specialty carbon blacks provide microscopic dispersion performance well beyond that of a conventional carbon black, allowing the ELFTEX products to meet the required standard (rating <3).

Chemical and physical cleanliness

Cleanliness of the carbon black is critical to pipe performance. Chemical cleanliness, particularly low sulfur, is required to meet strict standards around affecting the taste and odor of water. Other contaminants can also affect pipe performance, driving the need for p-type specialty carbon blacks. Our ELFTEX p-type carbon blacks meet all chemical cleanliness standards and provide exceptional performance by all measures when compared to a conventional carbon black, as shown in Figure 6.

Figure 4: Dispersibility comparison

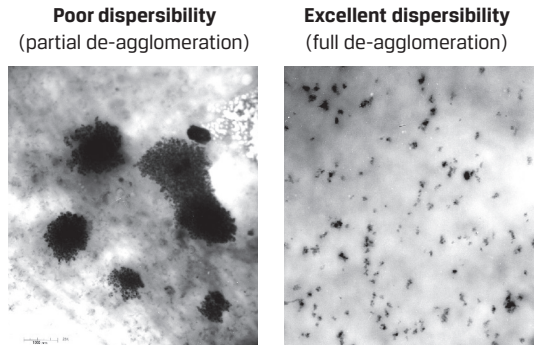


Figure 5: Carbon black microscopic dispersion performance

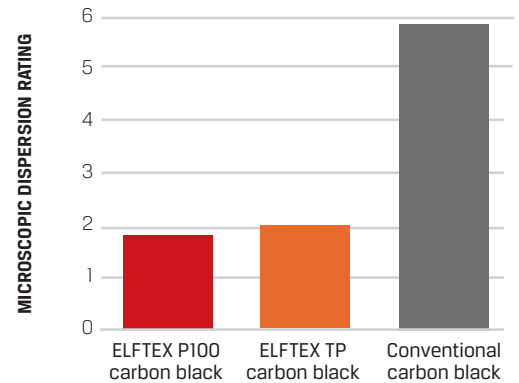
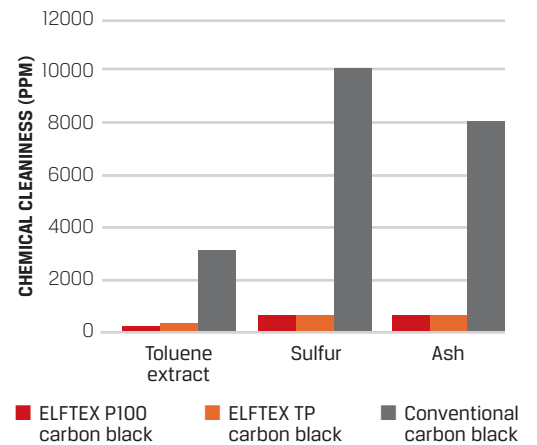


Figure 6: Carbon black chemical cleanliness performance



Compound moisture absorption

Compounds containing carbon black usually absorb some moisture upon exposure to air. This moisture can create surface defects and microvoids in finished pressure pipe; it can also cause processing problems (e.g., die build-up) due to migration of entrapped moisture through the compound during the extrusion process if the compound is not sufficiently dried. As shown in Figure 7, ELFTEx® P100 and ELFTEx TP specialty carbon blacks have been designed to promote low CMA levels, resulting in higher pipe quality.

Processability

Processability refers to the ease with which a customer can incorporate an additive into a formulation. It is a key design consideration and we understand the need to create products that provide the proper performance benefits as well as a high level of processability as measured along three dimensions:

- ◆ Dispersibility
- ◆ Masterbatch dilutability
- ◆ Polymer compatibility with HDPE

Our specialty carbon blacks are often formulated into masterbatches that are then used by compounders. Masterbatch dilutability is a measure of how easily a masterbatch can be distributed in, or mixed with, the dilution polymer. When masterbatch dilution is inadequate, non-homogenous pigmentation, lower UV performance and poor mechanical properties may occur.

Dilutability of a masterbatch is linked to viscosity, as measured by melt flow index (MFI). As shown in Figure 8, both ELFTEx P100 and ELFTEx TP specialty carbon blacks enable high MFI as compared to conventional carbon blacks, with ELFTEx P100 specialty carbon black providing the highest fluidity at a given carbon black dosage.

Figure 7:
CMA performance

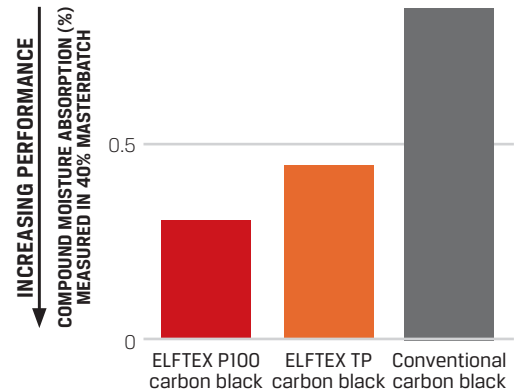
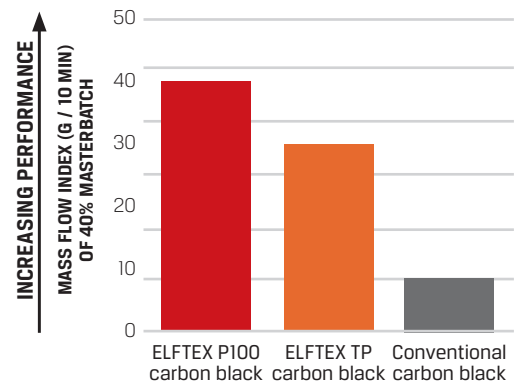


Figure 8:
MFI performance



Product data

Specialty carbon black product	Description
ELFTEX® P100	Specialty p-type specialty carbon black meeting all ISO-standards for UV performance in fully-formulated pipe compounds offering easy to disperse and premium moisture performance
ELFTEX TP	Standard p-type specialty carbon black that meets all ISO-standards for fully-formulated pipe compounds

Note: Both specialty carbon black products listed are in pellet form.

Additional references

This Product Application Guide provides specific information about our specialty carbon blacks for use in plastic pressure pipe. For other application-specific product recommendations and broader product portfolio information, please visit cabotcorp.com or contact your Cabot representative.

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