CARBON BLACKS

CABOT
creating what matters

P-type Blacks for Premium Performance in Pressure Pipe Applications

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ELFTEX® P100 is the latest Cabot P-type black for pressure pipe applications. It complements the existing grade ELFTEX TP. These two blacks are our response to the increasing need for a differentiated product range for pressure pipe applications. Each of these grades is specifically designed to meet a particular performance balance in terms of the five key performance criteria important to the pressure pipe compounds:

- Particle size
- Microscopic dispersion
- Compound moisture absorption
- Chemical impurities
- Dispersability

These P-type blacks are those which meet all of the following specifications all of the time.

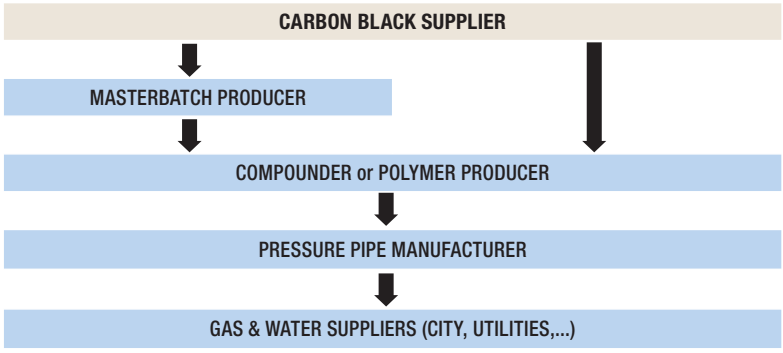
Property	Test Method	Limit
Total ash	ASTM D-1506	< 0.10%
Toluene extract	ASTM D-1618	< 0.03%
Total sulfur	CTM 15.71	< 0.10%
Particle size	ASTM D-3849	< 25 nm
325 Mesh residue	ASTM D-1514	< 20 ppm

These specifications are required for pressure pipe applications to meet the industry standards across the world.

Value Chain

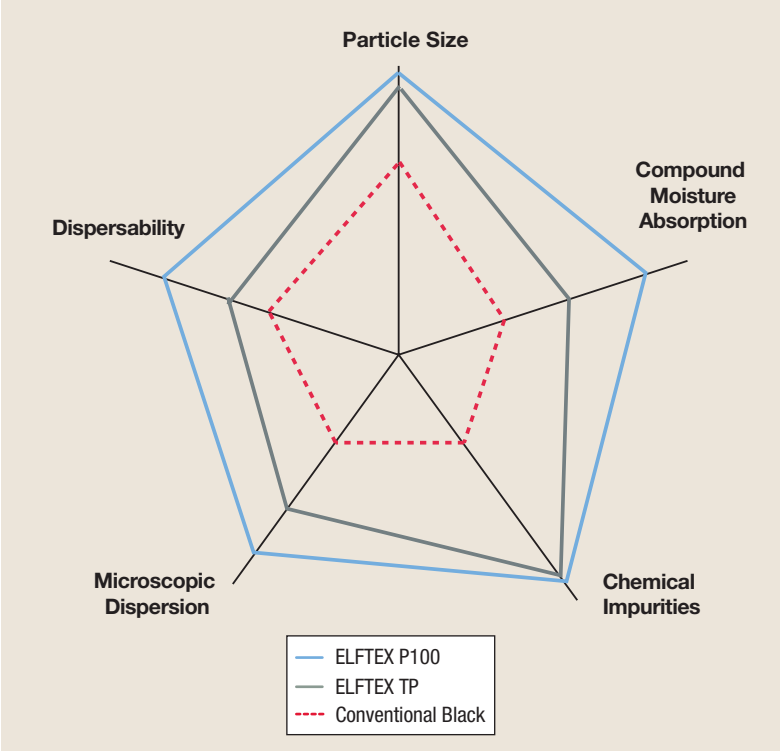
The value chain pictured here represents how P-type blacks cascade stream downward into the fabrication of plastic pressure pipes. The value chain for the plastic pressure pipe market is composed of 5 levels:

1. Carbon black suppliers
2. Masterbatch producers
3. Compounder or polymer producers
4. Pressure pipe manufacturers
5. Gas & water suppliers (city, utilities, etc.)

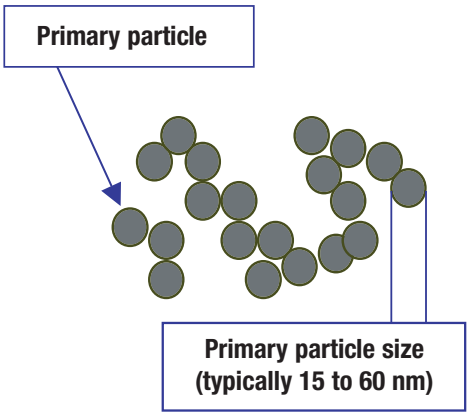


Star Diagram

A visual and accessible way to compare different P-type blacks on their relative suitability for the pressure pipe application is the star diagram. This star diagram compares the performance of P-type blacks in terms of the five key performance criteria. These performance measures are discussed in more detail in this brochure.



Performance improves from chart centre



Carbon black aggregate

Particle Size*

Carbon black is one of the most efficient and widespread light absorbers. Its efficiency as a UV absorber primarily depends on the primary particle size. At the same loading, carbon black aggregates, based on fine prime particles, will present more surface to incident light – and hence a larger ultraviolet light absorbing efficiency – than a coarser grade.

Fig. 1 - Effect of primary particle size on weathering performance

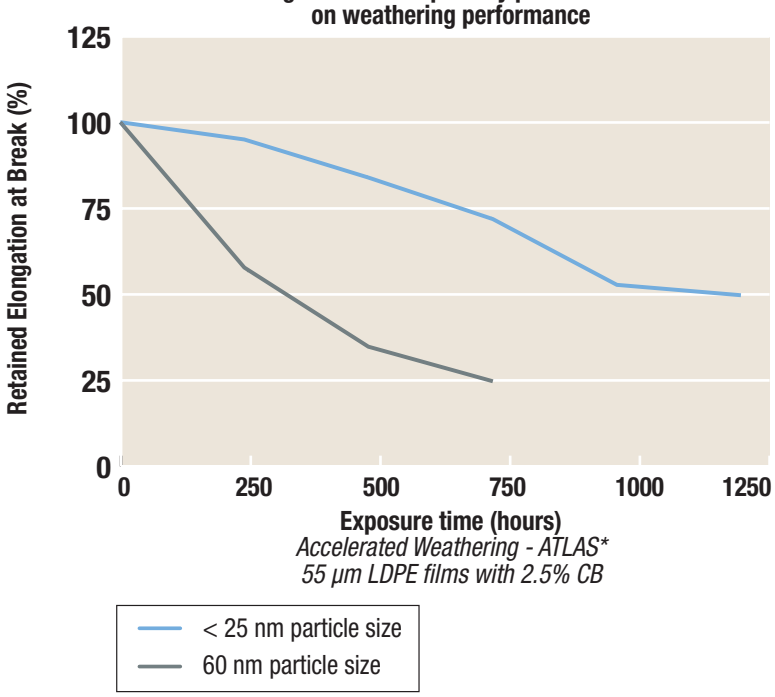


Fig. 1 shows that P-type blacks widely improve weathering performance versus conventional carbon black.

The appropriate loading level depends on the part thickness, exposure conditions and type of carbon black. Usual loading to impart optimum UV protection varies between 2 and 3% (it should be noted that these carbon black levels correspond to 5 to 7.5% masterbatch, as typical carbon black loading in the masterbatch is about 40%).

Fig. 2 - Effect of loading levels on ultraviolet light absorption

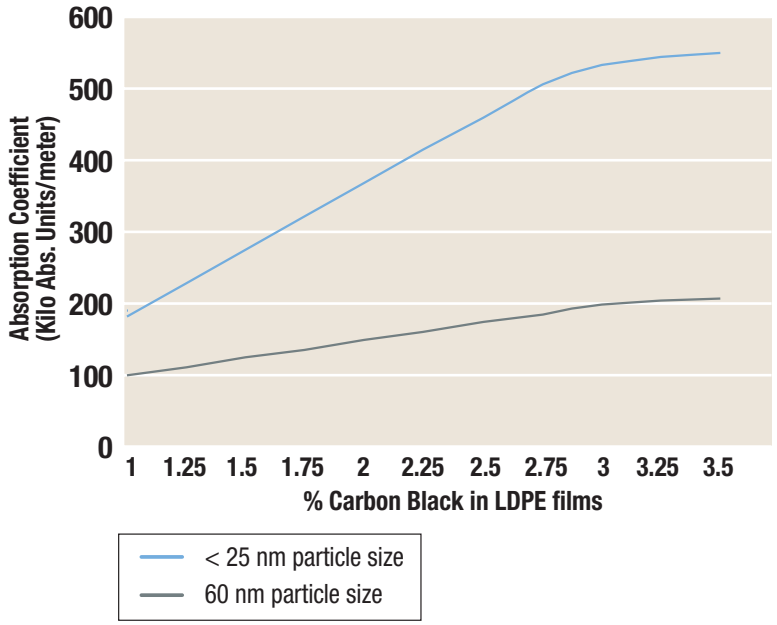


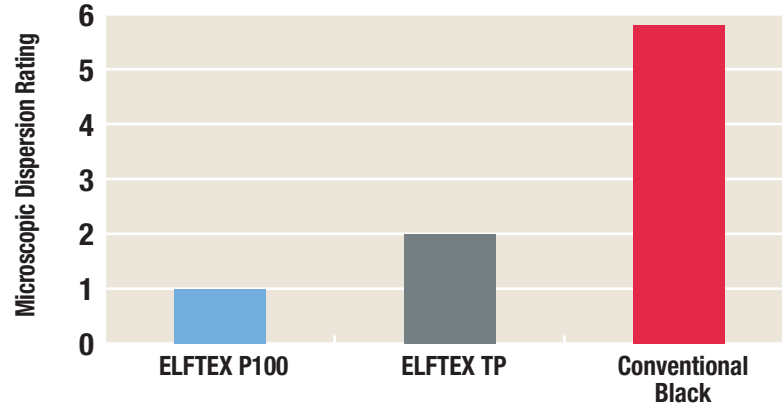
Fig. 2 shows that P-type blacks efficiently protect pipes against UV degradation.

Most of the national and international industry standards for pressure pipes recognize the importance of particle size with respect to UV stability. For that purpose, they specify a carbon black particle size of below 25 nm (like BS6730, NFT54-072, ISO/FDIS8779,...) and a carbon black concentration of 2.0-2.5 weight%.

** Please, also see "UV Weathering and Related Test Method" brochure.*

Microscopic Dispersion**

The most commonly used Microscopic Dispersion test is the "press-out method"; it involves examination of thin hot-pressed compound samples under an optical microscope using transmitted light.
A rating or grade is defined based on the size and number of undispersed carbon black agglomerates.



The presence of undispersed carbon black agglomerates in the pipe wall can lead to premature failure of the pressure pipe. Apart from the high cost of replacement and repair, a premature cracking of a gas conduit under pressure is also an obvious safety hazard.

The surface smoothness of the inner and outer wall of the pipe is also a very important performance criteria, both for aesthetics and for fluid flow properties.

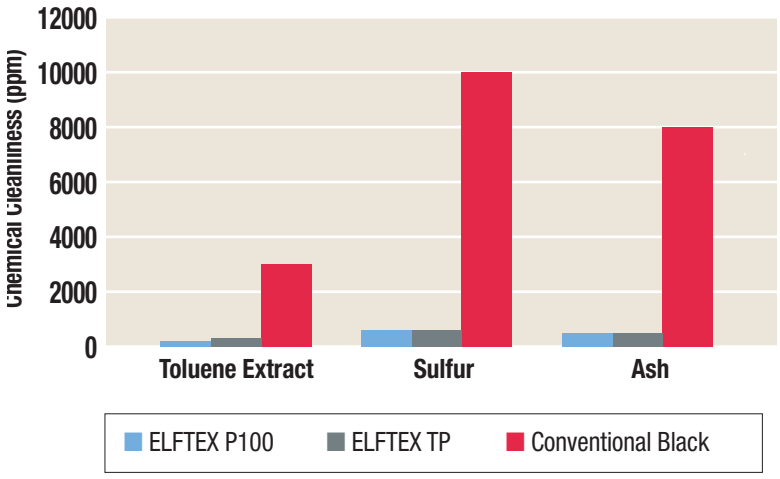
Most of the national and international industry standards for pressure pipes recognize this importance and specify a microscopic dispersion rating of < 3 (according to ISO 11420, NFT51-142).

ELFTEX P100 shows the best-in-class microscopic dispersion. In turn, ELFTEX TP still exhibits a superior performance compared to a conventional black.

** *Please, also see "Microscopic Dispersion Test for High Performance Pressure Pipes" brochure*

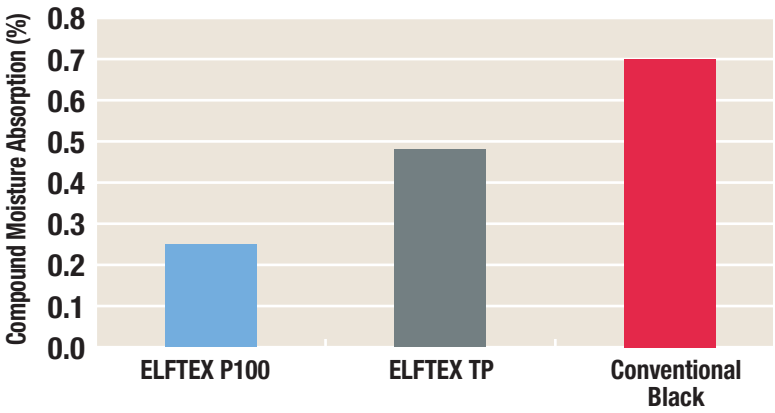
Chemical Cleanliness

There are very strict requirements on the compounds that are used to make pressure pipe for potable water. These requirements for the pressure pipes have been defined according to the industry knowledge of the factors that affect the drinking water taste and odor, well known in the industry as 'organoleptic' properties. These organoleptic requirements have been further translated into low sulfur impurity, ash, and toluene extract requirements by these regulatory agencies.



P-type blacks are especially characterized by a very low content of toluene extract, sulfur and ash.
As shown above, ELFTEX P100 and ELFTEX TP have very small amounts of sulfur impurities, ash, and toluene extract levels compared to a conventional black.

Compound Moisture Absorption



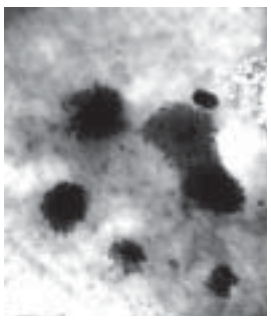
Compounds containing carbon black usually absorb some moisture upon exposure to air. This moisture absorption, or compound moisture absorption (CMA) as it is known in the plastics industry, can create processing problems (e.g. die drool) or surface defects or internal cavities in the finished part. This is due to the migration of entrapped moisture through the compound during the extrusion process if the compound is not sufficiently dried. The high purity of the P-type blacks makes it possible to reach low CMA level in the compound.

Dispersability

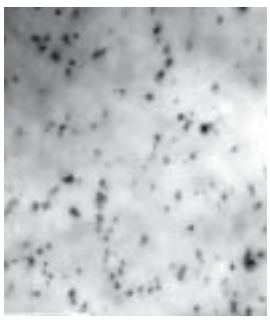
Carbon black dispersability indicates the ease with which the P-type black can be wetted with the resin and subsequently de-agglomerated.
This performance measure is dependent primarily on the fundamental characteristics of the carbon black. Considering the physics of nano particles, it represents the Van der Waals attractive force needed to separate the agglomerates into discrete carbon black aggregates.
This measure is independent of the polymeric system used to disperse the P-type black. It is also an indicator of the relative yields that can be achieved on the compounding equipment with the different carbon black grades.
For this reason, a particular effort on dispersability has been put in the development of ELFTEX P100. As a result, ELFTEX P100 has an improved dispersability over ELFTEX TP.

The 2 photomicrographs illustrate how dispersability of the carbon black affects the de-agglomeration and polymer wetting. It is easier to achieve full de-agglomeration and wetting with P-type blacks.

Poor Dispersability (partial de-agglomeration)



Excellent Dispersability (full de-agglomeration)



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