



Polymers

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# ELECTRONIC PACKAGING CARBON SOLUTIONS FOR POLYMERS

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**ENSACO®**  
Carbon Black



[www.imerys-graphite-and-carbon.com](http://www.imerys-graphite-and-carbon.com)

# Imerys Graphite & Carbon

## A STRONG COMPANY

Imerys Graphite & Carbon, member of the Imerys Group, is the reference for innovative capability in the field of carbon-powder-based solutions: natural graphite and synthetic graphite powders, conductive carbon blacks, as well as silicon-carbon composites and water dispersions. High standards in terms of employee health and safety, social behaviour and environmental responsibility are core values of the company, which is capturing opportunities by developing new products and applications, investing in assets & people, and growing its commercial presence worldwide.



### FINANCIAL STRENGTH



Profitable company, part of Imerys, the world leader in mineral-based specialty solutions for industry, listed on the Paris stock exchange

IMERYS GROUP 2017	
WORKFORCE	18,300
REVENUE	4.6 Bn
OPERATING MARGIN	14.1 %

### RELIABLE PARTNER



INNOVATION STRATEGY
■ Focused on the market and the Customer's needs
SECURITY OF SUPPLY
■ 5 Industrial sites
OUR DRIVING FORCE
■ Customer Service

### RESPONSIBLE GROWTH



COMMITMENT TO
■ Green Technology and Sustainable Development
REDUCTION OF
■ CO <sub>2</sub> Footprint
ENGAGEMENT WITH
■ Local Communities



# ESD - Electrostatic Discharge

## ESD

Plastic is a common electrical insulating material that charges quickly when in contact with other materials (other plastics, different materials like wood, or metals), and can discharge just as fast with a spark if the energy potential is high enough. This flow of electrons is called electrostatic discharge (ESD), and depending on its intensity, it can be audible, visible or completely undetectable. This sequence of events takes place due to the triboelectric effect, that is, the charge separation that occurs when two different materials are put in contact and then separated, or are in frictional contact. The effect of charge transfer can be dramatic in explosive environments as a spark can be enough to trigger a combustion or an explosive process. In the electronics industry, even a weak electrostatic discharge can change the electrical characteristics of a device, damaging or destroying it.



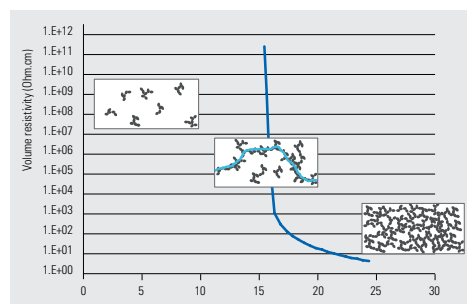
For these reasons, ESD must be prevented in hazardous environments (mining, gas and oil, explosive areas) and in many electronic device industries. As the triboelectric effect cannot be completely avoided, ESD programs tend to limit the electrostatic potential build up by dissipating the electrostatic charges. To do so, the charges that are formed must be dissipated by using dissipative plastic. The most common way to add electrical dissipation to plastic materials is through the addition of conductive carbon black to the polymer matrix.

### ELECTRICAL CONDUCTIVITY REQUIREMENTS

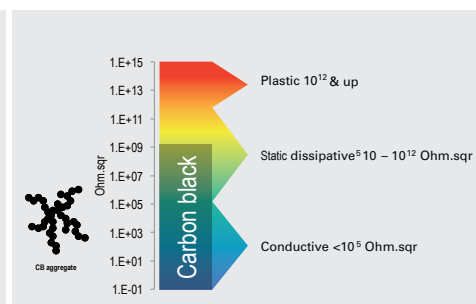
ELECTRONIC COMPONENT	SENSIBILITY THRESHOLD
CMOS	250 - 3000 Volt
OP-AMP	190 - 2500 Volt
VMOS	30 - 1800 Volt
MOSFET	100 - 200 Volt
GaAsFET	100 - 300 Volt
EPROM	100 Volt
BI-POLAR TRANSISTOR	380 - 7000 Volt
SCHOTTKY DIODES	300 - 2500 Volt

## ENSACO® CONDUCTIVE CARBON BLACK

Conductive carbon blacks are special branched carbons with a graphitic structure, that are able to transport the flow of electrons. At a certain concentration point of carbon blacks (percolation threshold), a conductive network is formed inside the insulating polymeric matrix that, if grounded, can dissipate the electrostatic charges formed. Conductive carbon black filled plastics can cover a wide range of resistivity reaching few Ohm.cm at high loadings.



Typical percolation curve of carbon black in a polymer



Range of conductivity of CB loaded plastics

# ENSACO® Conductive Carbon Black

## ENSACO® CONDUCTIVE CARBON BLACK

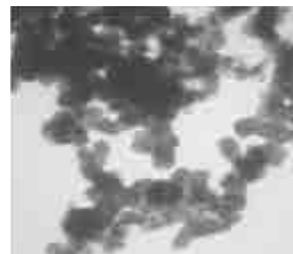
Imerys Graphite & Carbon's ENSACO® carbon blacks are a special family of electrically conductive carbon blacks, produced through a proprietary method, that deliver extremely pure products with many advantages over the conventional alternatives.



CB primary particle



CB aggregate

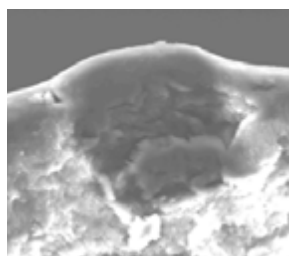


CB agglomerates

## EASILY DISPERSIBLE

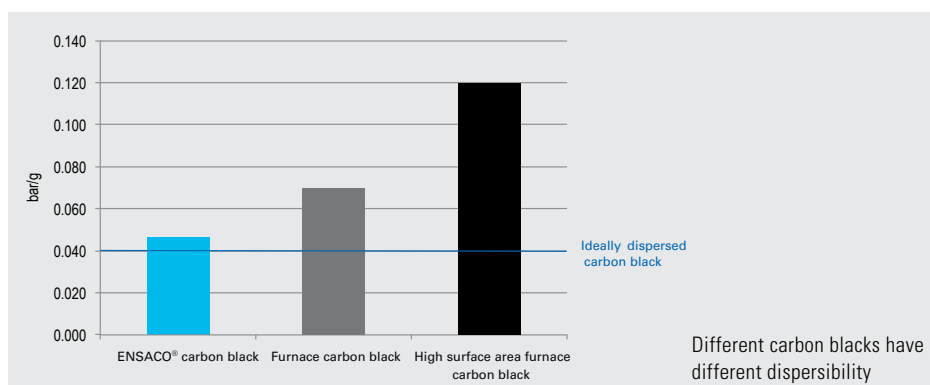
Not all carbon blacks can be dispersed at the same level. The grade of dispersion depends on many factors, such as the polymer type and the grade or the mixing process used. Imerys Graphite & Carbon's ENSACO® carbon blacks are well known in the industry to be extremely easily dispersible, due to their high structure and low surface area. The specific high structure/low surface area combination achievable through Imerys Graphite & Carbon's process helps dispersion, since the low surface area improves polymer wetting, while the high structure decreases the contact forces between the aggregates.

Grits and undispersed carbon black are a problem as they are a weak point and can induce mechanical and electrical failure.



Grits and undispersed carbon black

For demanding applications, the melt must be filtered during compounding operations. One way to quantitatively classify the dispersion grade of carbon black is by measuring the filter pressure value (FPV). A certain quantity of carbon black compound is pushed through a very narrow filter, and the filter pressure (the rise of pressure due to the partial blocking of the filter) value is inversely proportional to the dispersion grade (the lower the FPV, the better the dispersion).

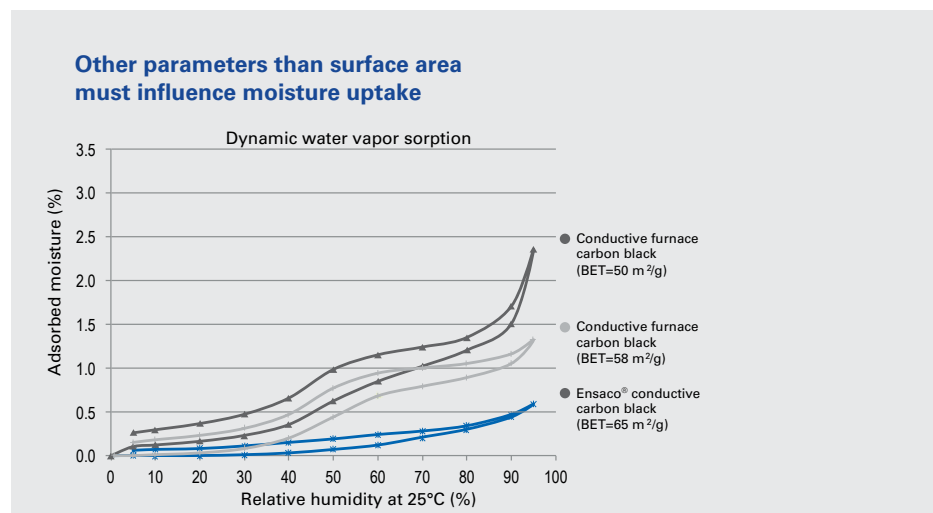
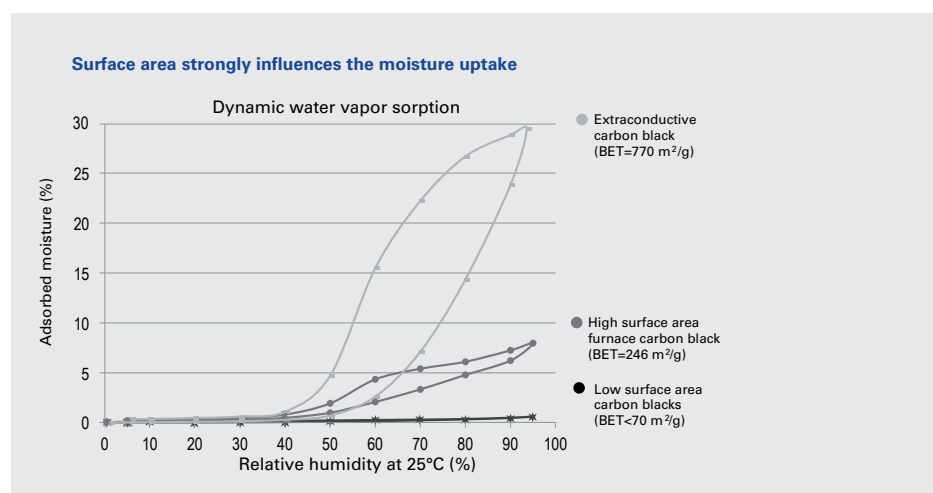


ENSACO® carbon black has a low FPV value, and it is extremely easy to disperse also due to its excellent surface qualities. Moreover, low FPV means low machine melt filter change rate, with the resulting improved productivity. This is critical in demanding applications such as thin sheet and film applications, in which very high dispersion is mandatory, and melt filtration is more frequently used.

## LOW MOISTURE ABSORPTION

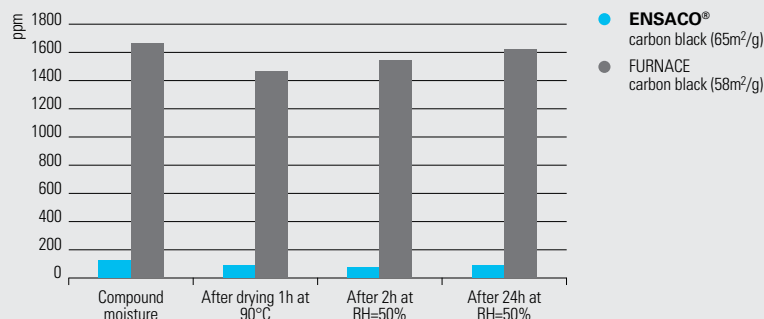
Water uptake is known to affect dispersion and is also responsible for the formation of bubbles or for degradation in sensitive polymers. Although carbon materials have hydrophobic surfaces and therefore low moisture uptake, the high surface of carbon blacks can induce considerable amounts of absorbed water when exposed to humid environments. The figures below show that the amount of water absorbed is usually proportional to the carbon black surface area. For this is reason, high surface area carbon blacks are known to readily absorb large amounts of water (for example extra-conductive carbon blacks can have 30 %w/w of water uptake).

### CARBON BLACK MOISTURE UPTAKE



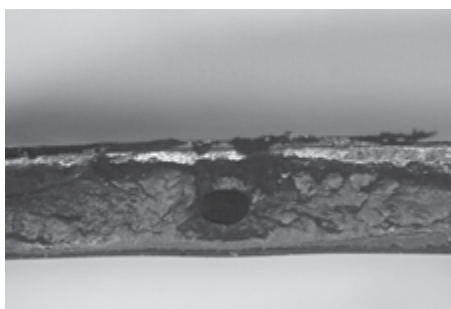
The low surface area of ENSACO® 250G and ENSACO® 260G is the main reason for the very limited water uptake. Furthermore, due to ENSACO®'s specific manufacturing process, which reduces surface oxidation, ENSACO® 250G and ENSACO® 260G have the lowest moisture uptake on the market, much lower than other furnace carbon blacks of similar surface area. Polymer compounds produced with ENSACO® carbon black have much lower water content than those produced with other furnace carbon blacks on the market.

**Once in the compound, moisture cannot be removed.**



Moisture content of PP compounds of same conductivity (100 Ohm.cm) (measured by Karl Fischer).

Furnace carbon black compounds with high moisture content are prone to form bubble defects in the final material. ENSACO® 250G and ENSACO® 260G are then especially suitable for production plants located in humid areas (for example in Asia), or when water sensitive polymers are used (for example polyamides or polycarbonates).



Carbon blacks with high moisture content can induce bubble defects in the final material.



No surface defects. Excellent products can be obtained with IMERYYS Carbon Blacks.

## HIGH PURITY

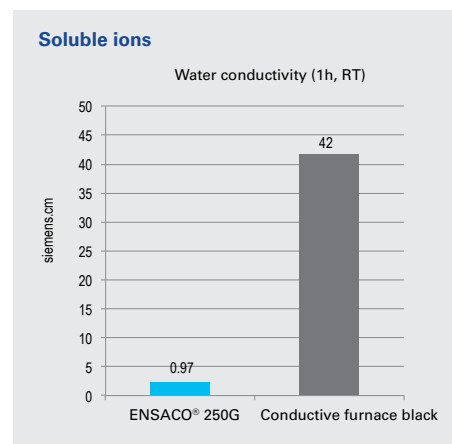
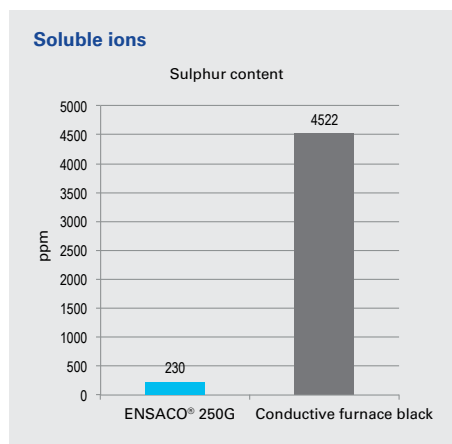
Carbon blacks purity can vary according to the application in which they are used, for example tyre carbon blacks are known to be less pure, while conductive carbon blacks are generally known to be pure.

### Impurities have different origins and can be classified as follows:

- Non-combustible material (commonly referred to as ashes)
- Sulphur
- Grits
- Non-combusted oils/raw material

The ash content is the amount of material that remains after the combustion of the carbon component at the high temperature of (550°C), and it is mainly composed of transition metal oxides and salts. These transition metal ions can be responsible for long term polymer degradation as some of them are known to have catalytic effects on the polymer chain (for example Copper, Iron, etc.). Although this subject of general interest has not been investigated in detail, purity of carbon black is key in the electronic packaging industry, as soluble ions can migrate to the surface and induce corrosion of the electronic equipment. For this reason, many ESD programs of specific electronic industries have limits on the ions contained in the final plastic object. It is clear that the starting water soluble ion content of the carbon black is of utmost importance if the material is intended for sensitive electronic packaging applications. Among conductive carbon blacks, ENSACO® is known to have very low metallic impurities, with low ash content and more than one order of magnitude lower content of soluble species. Low Sulphur and grit content are normally lower than the other conductive carbon blacks as well, making ENSACO® carbon blacks unique products for demanding applications.

## ENSACO® CONDUCTIVE CARBON BLACK PROPERTIES



Small amount of non carbon atoms can be present in carbon black. ENSACO® are extremely pure carbon blacks.

This kind of impurities can generate water soluble species. Ionic leakage of ENSACO® carbon black is extremely low.

### ENSACO® TYPICAL VALUES

PROPERTY TEST METHOD	UNIT	ENSACO® 250G	ENSACO® 260G	ENSACO® 350G	ENSACO® 360G
<b>Form</b>		<b>Granules(*)</b>	<b>Granules</b>	<b>Granules</b>	<b>Granules</b>
<b>BET nitrogen surface area</b> ASTM D3037	m <sup>2</sup> /g	65	70	770	780
<b>OAN absorption</b> ASTM D2414 (1)	ml/100g	190	190	320	320
<b>Pour density</b> ASTM D1513	kg/m <sup>3</sup>	170	170	135	135
<b>Ash content</b> ASTM D1506	%	0.01	0.01	0.03	0.03
<b>Sulphur content</b> ASTM D1619	%	0.02	0.02	0.02	0.02
<b>Benzo[a]pyrene</b>	ppb	<20	<20	<20	<20

### ENSACO® TYPICAL EFFECTS ON POLYMER COMPOUNDS

PROPERTY	ENSACO® 250G	ENSACO® 260G	ENSACO® 350G	ENSACO® 360G
<b>Form</b>	<b>Granules(*)</b>	<b>Granules</b>	<b>Granules</b>	<b>Granules</b>
<b>Conductivity</b>	+++	+++	++++	++++
<b>Dispersibility</b>	+++	+++	++	++
<b>Purity</b>	+++	+++	++	++
<b>Surface smoothness</b>	+++	+++	++	++
<b>Water absorption</b>	very low	very low	high	high
<b>Resistance to Shear</b>	+++	++++	+++	+++

(1) Spring: 0.9 lbs/inch; 10 g of carbon black

(\*) ENSACO® 250 is also available in powder form.



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