CARBON HYBRID SOLUTIONS TO GIVE POLYMERS ELECTROMAGNETIC INTERFERENCE SHIELDING PROPERTIES

TIMREX® C-THERM™ High Aspect Ratio Graphite ENSACO® Carbon Black





IMERYS HIGH ASPECT RATIO GRAPHITES AND CONDUCTIVE CARBON BLACKS – SOLUTIONS FOR ELECTROMAGNETIC SHIELDING SYSTEMS

21.0°C IIM

273 km

206.mm

APPLICATIONS FOR ELECTROMAGNETIC INTERFERENCE SHIELDING POLYMERS

There is a growing need for EMI (Electromagnetic Interference) shielding systems in applications such as:

- Selectronic devices such as mobile phones or tablets
- Selectronic control units or advanced driver assistance systems used in automotive applications

Wireless communications or electronic systems such as cables or motors generate electromagnetic waves which can interfere with other electronic systems. EMI shielding is necessary to reduce the risk of this interference. When there is a need for reliable polymer-based EMI shielding solutions, Imerys Graphite & Carbon's ENSACO[®] Conductive Carbon black, and specialty high aspect ratio TIMREX[®] C-THERM[™] graphites are ideal additives to achieve the desired combination of:

- 𝔄 High electrical conductivity
- 𝔅 High electromagnetic signal attenuation
- 𝔄 High thermal conductivity
- 𝔄 Good processability





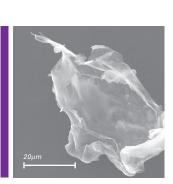


IMERYS CARBON HYBRID SOLUTIONS FOR ELECTROMAGNETIC INTERFERENCE SHIELDING POLYMERS

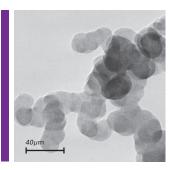
ENSACO® CONDUCTIVE CARBON BLACK & TIMREX® C-THERM™

Imerys Graphite & Carbon's ENSACO[®] is a cutting-edge conductive carbon black, with a winning combination of high purity, high structure and low surface area, which guarantees low moisture pick-up as well as easy dispersion. This unique set of properties enables high levels of electrical conductivity at low loadings.

TIMREX[®] C-THERM[™] are specialty graphites with an extremely high aspect ratio, designed for applications requiring superior electrical and thermal conductivity at low carbon contents.

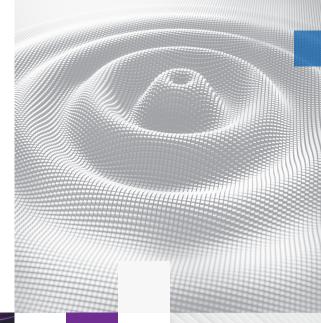


TIMREX[®] C-THERM[™] High aspect ratio graphites

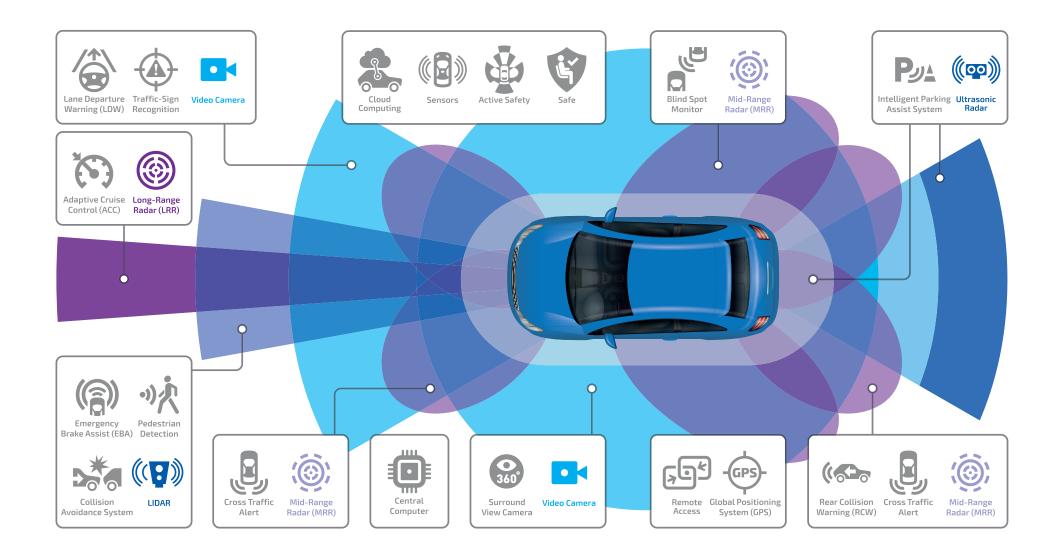


ENSACO® 250G Conductive Carbon Black









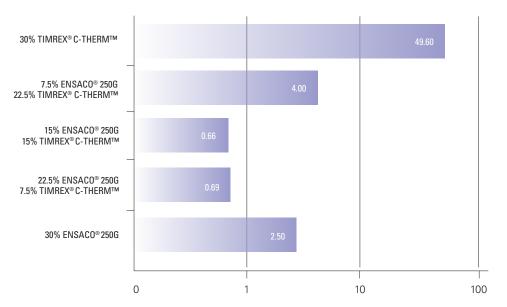
KEY BENEFITS

HIGH ELECTRICAL CONDUCTIVITY

One of the key factors to provide EMI shielding is to use highly electrically conductive materials.

Polypropylene based compounds were prepared using 30% ENSACO[®] 250G conductive carbon black, 30% high aspect ratio graphite TIMREX[®]C-THERM[™] and blends of the two combined.

- ✓ Formulations based on ENSACO[®]
 as a single additive are more conductive
 than those made with TIMREX[®] C-THERM[™]
 (above approx. 15wt%)



Volume resistivity (Ohm.cm)

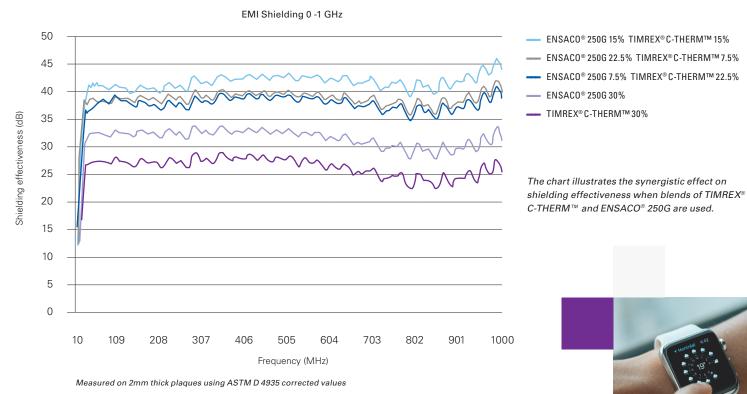
Volume resistivity of PP with 30% carbon additive Evolution with growing loading of TIMREX[®] C-THERM[™]



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EMI SHIELDING PERFORMANCE

Improving the electrical conductivity performance of a compound has a direct impact on its EMI shielding effectiveness. At a 30% total carbon additive concentration, blends of ENSACO[®] 250G and TIMREX[®] C-THERM[™] exhibit a higher performance compared to the compounds based on a single additive, with the highest shielding effectiveness obtained with the 50% ENSACO[®] 250G/ 50% TIMREX[®] C-THERM[™] blend.

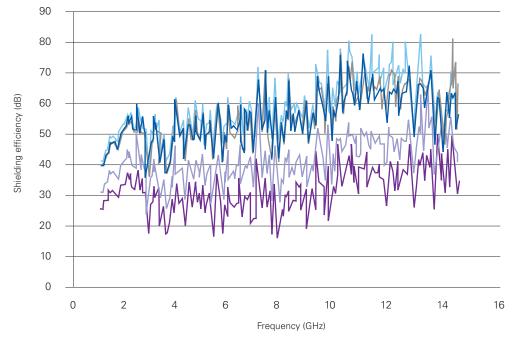


PP composities with 30% carbon additives

The same formulations were also tested for EMI shielding at frequencies from 1 to 14 GHz using a method derived from IEE299.

Shielding up to 70-75 dB is measured for the blends of ENSACO[®] 250G and TIMREX[®] C-THERM[™].

All the blends performed significantly better than compounds based on a single additive.



EMI shielding 1-14GHz



- ENSACO[®] 250G 22.5% TIMREX[®] C-THERM[™] 7.5%
- ----- ENSACO[®] 250G 7.5% TIMREX[®] C-THERM[™] 22.5%
- --- ENSACO[®] 250G 15% TIMREX[®] C-THERM™ 15%
- ----- ENSACO® 250G 30%
- ---- TIMREX[®]C-THERM[™] 30%



Measured on 2mm thick plaques using ASTM D 4935 corrected values

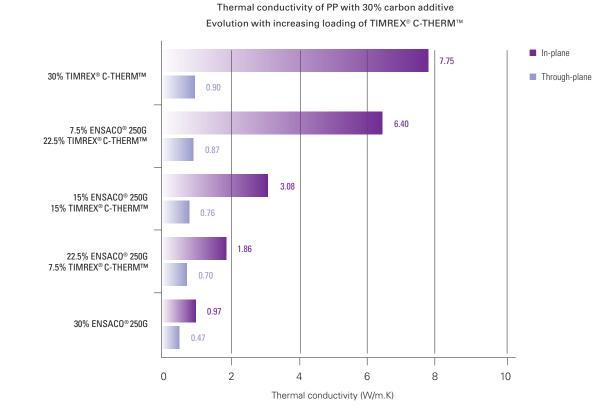
PP composities with 30% carbon additives

KEY BENEFITS

THERMAL CONDUCTIVITY

High power density electronic devices are often located in confined spaces making thermal management essential.

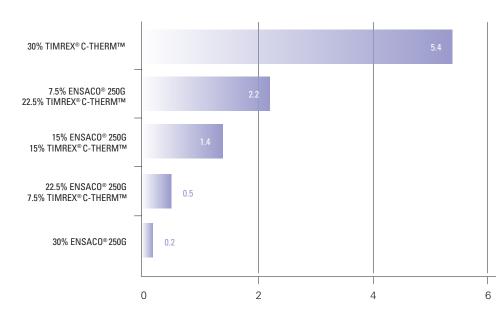
TIMREX[®] C-THERM[™] is the ideal solution for thermal management.





PROCESSABILITY

Fluidity is an essential property of compounds used to make complex or thin components. Increasing the portion of **TIMREX[®] C-THERM[™]** in the blend will increase the melt flow index (MFI), or fluidity of the compound.

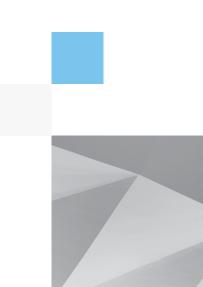


MFI (g/10min)

MFI (230°C, 5kg) for PP with 30% carbon additive

Evolution with increasing loading of TIMREX[®] C-THERM[™]





IMERYS GRAPHITE & CARBON – A STRONG INNOVATIVE COMPANY

Imerys Graphite & Carbon is a global company focused on delivering carbon based solutions for manufacturing and industry.

We have over 100 years of experience in the development and production of a wide variety of high quality synthetic and natural graphite powders, conductive carbon blacks, silicon carbide and water based dispersions for various end applications including, but not limited to:

- ℅ Lithium-ion Batteries
- ⊘ Alkaline Batteries
- ⊗ Lead Acid Batteries
- Solution Conductive Polymers, Plastics and Rubbers
- ⊘ Carbon Brushes
- Solution Brake Pads and Clutches
- Solution Powder Metallurgy and Hard Metals
- **⊘** Refractories

Our team of over 500 experienced professionals ensures we deliver optimal solutions for the technical challenges faced by our customers making us the market leader for:

- Conductive carbon blacks and graphites for lithium-ion batteries
- ♂ Graphites for alkaline batteries
- S Graphites for resin bonded carbon brushes
- Solutive carbon blacks for conductive polymers

IMERYS GROUP

Imerys Graphite & Carbon belongs to Imerys Group, the world leading supplier in mineral based specialties for industry.

The Group draws on its understanding of applications, technological knowledge and expertise in material science to deliver solutions based on beneficiation of its mineral resources, synthetic minerals and formulations. These contribute essential properties to customers' products and their performance, including heat resistance, hardness, conductivity, opacity, durability, purity, lightness, filtration, absorption and water repellency.

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