Thermal Conductivity
Graphite Solutions for Polymers

- Highest purity with synthetic graphite
- Consistent quality
- Regulatory compliance
- High performance

Contact us for further information on our products.
www.imerys-graphite-and-carbon.com
Graphite Solutions for Thermally Conductive Compounds

METAL REPLACEMENT

The use of polymers to achieve thermal conductivity offers substantial advantages compared to standard metal-based technologies in terms of:

- Weight reduction;
- Design flexibility;
- Corrosion resistance;
- Manufacturing cost reduction.

Since polymers are inherently thermally insulating (<0.5 W/m.K), conductive fillers have to be added in order to provide the requested thermal conductivity. Graphite-based fillers are known to be the most effective conductive additives for polymers, combining the best features in terms of performance and price.

**In-plane thermal conductivity of polyamide plastic compounds in comparison to steel and aluminum.**

AUTOMOTIVE HEADLAMP

Graphite thermally conductive compounds may be found in automotive headlamps. LED lamps need to dissipate thermal energy in order to reduce the operating temperature that is known to reduce the lamp lifetime. Along with the LED heat sink, many other components of the lighting unit and housing structure are made of plastics, and increasing their thermal conductivity can further decrease the operating temperature.

**BEYOND LED LAMPS**

Beside LED lamps, a world of specific applications requiring thermal conductivity can be found in the automotive sector, as well as in other sectors such as household appliances. Metal replacement is an increasing trend, and Graphite is the most efficient and affordable additive, allowing to manage thermal conductivity to the desired level.

**Thermal conductivity of a generic graphite loaded compound.**
In some cases the high thermal conductivity of metals can be unnecessary, meaning that a different level of thermal conductivity is required for each specific application. If we have to cool down a heating element, and we may use the LED lamp example again, most of the heat transfer is usually convection limited (air cooling).

Thermal dissipation of LED lamp, air convection is the limiting step.

The question is related to how much conductivity can be reached with graphite filled plastics. Imerys Graphite & Carbon’s expertise and field applications demonstrate that compounds with graphite additions can increase thermal conductivity well above 10 W/mK in the \textit{in plane} component. As a reference, stainless steel has a thermal conductivity of 15 W/mK.

Different requirements must be taken into account for different applications. This influences the selection of additives that are used in the compound.

Heat fluxes in heat sink and pipe applications: heat sink needs high \textit{in plane} thermal conductivity while pipe applications need high \textit{through plane} thermal conductivity.

Graphite is known to be a flaky material giving anisotropic thermal conductivity. Depending on the application requirement, a specific graphite grade can be chosen, increasing the thermal conductivity in the desired direction.

IMERYS Graphite & Carbon has the expertise to give you advice on the best grade according to both your thermal conductivity and mechanical properties requirements.

Thermal conductivity of propylene compounds loaded with two graphite grades. Different graphites give different anisotropy.
Graphite is a fascinating material and it can be of natural origin or synthetic. Imerys Graphite & Carbon is able to provide both materials depending on the customer’s request. Synthetic graphite is known to be very pure, without any microcrystalline silica content, a contaminant that can be detrimental for health. Pure graphite is also important for applications that are exposed to severe environmental conditions (such as high temperature, fuel or chemical contact, etc.), or for drinking water applications. In those applications, contamination (transition metal ions) can catalyze polymer degradation, or migrate to surface, thus contaminating other materials.

Imerys Graphite & Carbon’s TIMREX® C-THERM® graphites are special solutions with an extremely High Aspect Ratio. When compared with standard graphites, TIMREX® C-THERM® can be used at lower loading to reach similar thermal conductivity (injection molding), both in through plane and in plane applications.

Another highlight regarding the mechanical properties of TIMREX® C-THERM® graphites is related to its good performance when combined with fiber reinforced plastics.

The main advantages of this product range are:
- Weight saving due to the lower loading needed to achieve compound thermal conductivity target;
- Higher mechanical properties in fiber reinforced materials.
Imerys Graphite & Carbon’s goal is to satisfy the requirements of thermal conductivity in a large variety of applications. We can supply a wide range of graphite solutions for thermal management. We offer technical support for in plane and through plane thermal management of polymer components, orientation on carbon additive loading, as well as advice on the effect of various processing techniques.

For further information, product selection and sampling, feel free to contact us, or visit our website: www.imerys-graphite-and-carbon.com.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>GRAPHITE TYPE</th>
<th>PARTICLE SIZE (approx)</th>
<th>ASH (max %)</th>
<th>BET (cm²/g)</th>
<th>SCOTT DENSITY (g/cm³)</th>
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<tbody>
<tr>
<td>KS44</td>
<td>Primary Synthetic Graphite</td>
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*Tap Density, DIN ISO 787-11

Graphite Solutions for Polymers

- TIMREX® Graphite
- TIMREX® C-THERM™ Graphite
- R&D Laboratories
  - Product Development
  - Application Development
  - Scientific Support to Customers

Applications

- Security of Supply
- Innovative Sustainable Solutions
- Customization

Added Value Processes
- Size Reduction
- Surface Modification
- Shape Modification
- Purification
- Exfoliation
- Mixing
- Sieving
- Milling
About Imerys Graphite & Carbon

Imerys Graphite & Carbon, member of 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 employees’ 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 2016)
- Workforce: 16,000
- Revenue: 4.1 Bn
- Operating margin: 14%

### RELIABLE PARTNER

- Innovation strategy: Focused on the market and Customers’ needs
- Security of supply: 6 Industrial Sites
- Our driving force: Customer Satisfaction

### RESPONSIBLE GROWTH

- Commitment to Green technology and Sustainable development
- Reduction of CO₂ Footprint
- Engagement with Local Communities

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