SPECIALTY GRAPHITE FOR NEGATIVE ELECTRODES OF LITHIUM-ION BATTERIES

C-NERGY™ Graphite

C-NERGY™ L-SERIES is a specialty graphite range especially designed for negative electrodes of lithium-ion batteries.

Key Features
- Enables the utilization of more economical active materials in the negative electrode
- Enables reduced additive dosage in the negative electrode
- Reduction of global additives cost (in negative and in positive electrodes)
- No additional pre-dispersing unit is required
- No need for a dispersing agent
- Faster electrolyte absorption
- Higher production outputs

<table>
<thead>
<tr>
<th>PRODUCT CHARACTERISTICS</th>
<th>APPLICATION BENEFITS</th>
</tr>
</thead>
</table>
| **Very High Purity**                                                                   | • Increased battery safety  
• Lower rejection rate  
• Fully compatible with most electrolyte systems |
| • Ultra low metal impurities  
• Ultra low ionic impurities                                                            |                                                                                     |
| **Very High Electrical Conductivity and Reversible Capacity**                          | • High energy density  
• Extremely high cycling stability  
• High charge acceptance  
• Lower dosage required vs conventional graphite grades  
• Reduced global additives costs |
| • Extremely high crystallinity  
• Very high electrical conductivity  
• Extremely high reversible capacity                                                    |                                                                                     |
| **High Density and Low Spring Back**                                                   | • High energy density  
• High charge acceptance  
• Minimal electrode expansion after pressing  
• Improved electrode flexibility  
• Facilitates the addition of other conductive additives |
| • High electrode density  
• High electrode compressibility  
• Significantly improved mechanical strength of the electrode                            |                                                                                     |
| **Very Efficient Electrolyte Wettability**                                            | • Cost reduction due to faster dispersion in water based electrode slurry  
• Cost reduction due to a faster electrolyte filling step in battery assembly  
• Improved battery performance due to more efficient anode wetting  
• Lower dosage required vs conventional graphite grades  
• Reduced global additive costs |
| • Rapid electrolyte absorption  
• Very high electrical conductivity  
• Extremely high reversible capacity                                                    |                                                                                     |

www.imerys-graphite-and-carbon.com
The unique characteristics of C-NERGY™ L-grades give unmatched performance improvement in Li-ion batteries.

**Recommended C-NERGY™ L-grades dosage in negative active material: 2-8 wt%**.

C-NERGY™ L-grades build a graphite matrix that facilitates the addition of other conductive additives.

Better performance is obtained when C-NERGY™ L-grades are used in combination with ca. 1 wt% of C-NERGY™ SUPER C65 or C-NERGY™ SUPER C45 carbon black.

### Typical Product Properties

<table>
<thead>
<tr>
<th></th>
<th>Ash (%)</th>
<th>Fe (ppm)</th>
<th>Cl (ppm)</th>
<th>SO$_4^2-$ (ppm)</th>
<th>AMOUNT OF MAGNETIC PARTICLES/GRAM OF PRODUCT</th>
<th>TIME TO ADSORB DMC ELECTROLYTE SOLVENT (msec)$^1$</th>
<th>TIME TO ADSORB WATER (msec)$^1$</th>
<th>ELECTRODE DENSITY (g/cm$^3$)</th>
<th>SPRING-BACK (%)</th>
<th>REVERSIBLE CAPACITY (Ah/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFG15L</td>
<td>0.01</td>
<td>10</td>
<td>5</td>
<td>25</td>
<td>&lt;1</td>
<td>100</td>
<td>300</td>
<td>&gt;1.75</td>
<td>10</td>
<td>370</td>
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<td>200</td>
<td>500</td>
<td>&gt;1.75</td>
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<td>370</td>
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<tr>
<td>KS15L</td>
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<td>13</td>
<td>355</td>
</tr>
</tbody>
</table>

More data available upon request

$^1$ Defined as time it takes to reach a contact angle of $0^\circ$

### Density of C-NERGY™ ACTILION 1 electrodes containing C-NERGY™ SFG 15L

Binder material: 1.5 wt.% SBR/1.5 wt.% CMC

Influence of C-NERGY™ SFG 15L on the cycling stability of C-NERGY™ ACTILION 1 electrodes

Lithium half-cells, 1C/3D (CCCV)

Binder material: 1.5 wt.% SBR/1.5 wt.% CMC

Electrode density: 1.7 g cm$^{-3}$

Electrolyte: 1 M LiPF$_6$ in EC/EMC 1:3 (w/w)