SPECIALTY CARBONS FOR **ALKALINE BATTERIES**

TIMREX®
Primary Synthetic Graphites

TIMREX®
High Aspect Ratio Graphites

TIMREX®
Graphite Dispersions

IMERYS

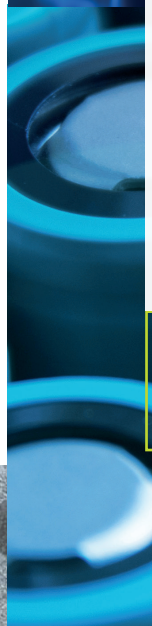
ADVANCED KNOWLEDGE AND EXPERTISE – FOR HIGH QUALITY, HIGH PERFORMING SOLUTIONS

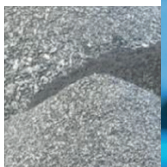
EXPERTS IN CARBON BASED CONDUCTIVE ADDITIVES

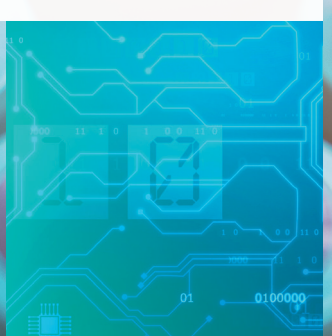
Imerys Graphite & Carbon have been experts in the field of electrochemical applications for graphite since the 1970s.

Our solutions include a wide range of high performance conductive additives for the EMD (electrolytic manganese dioxide) cathode ring of alkaline batteries. In addition, we offer graphite dispersions for battery can-coatings allowing manufactures to optimize battery performance and production efficiency.

Our unique manufacturing processes ensure the purity, quality and consistency of our products. The processes are all developed in-house and cannot be matched, making us the world-leader in conductive additives for the alkaline battery market.







TIMREX® GRAPHITE SOLUTIONS FOR ALKALINE BATTERIES

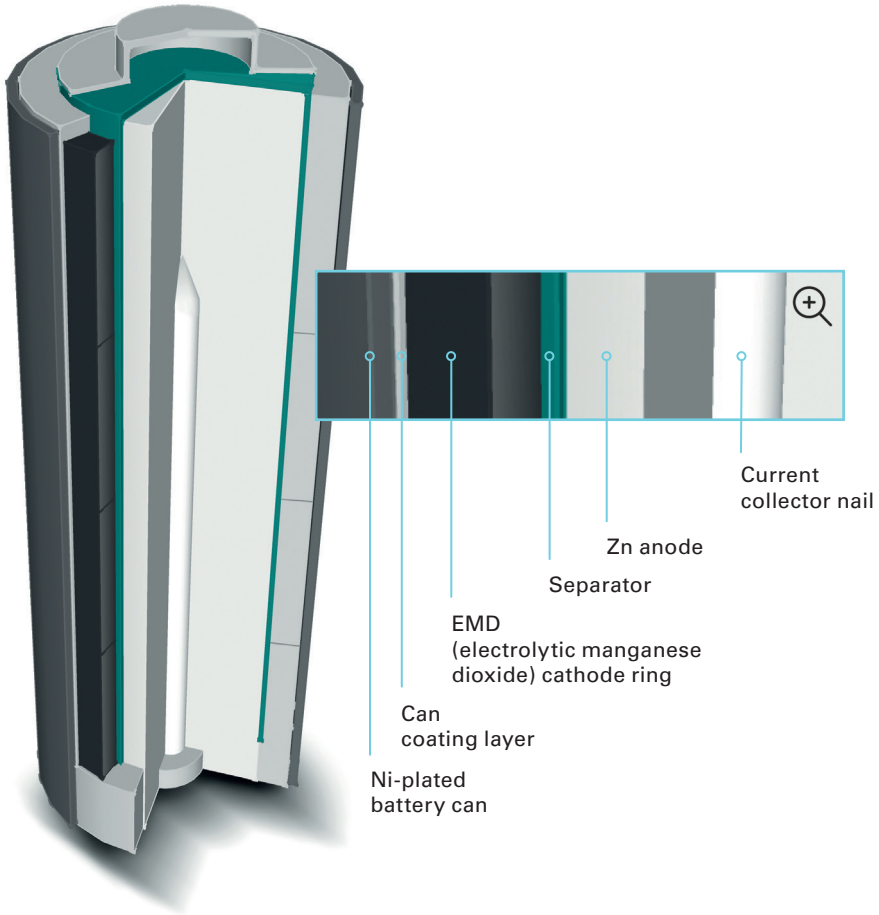
EFFICIENCY & PERFORMANCE

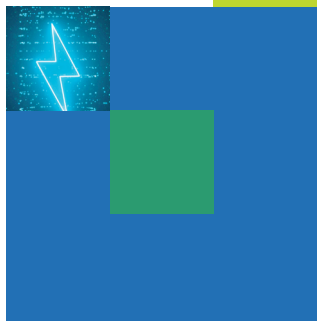
TIMREX® Primary synthetic powders and high aspect ratio graphites include a complete portfolio of conductive additives for the EMD cathode ring of alkaline batteries.

Imerys Graphite & Carbon's unique manufacturing processes have been developed internally to ensure full control of product characteristics and therefore consistent performance for the battery producer. We work closely with our customers to find the ideal solution to optimize their production efficiency and product performance.

Key benefits include:

- High electrical conductivity
- Exceptional processability and workability improving production efficiency
- High purity ensuring safety and reducing rejection rate
- Consistency of particle size and shape giving manufactures full control on final production quality
- High performance to price ratio





TIMREX® PRIMARY SYNTHETIC POWDERS & HIGH ASPECT RATIO GRAPHITES

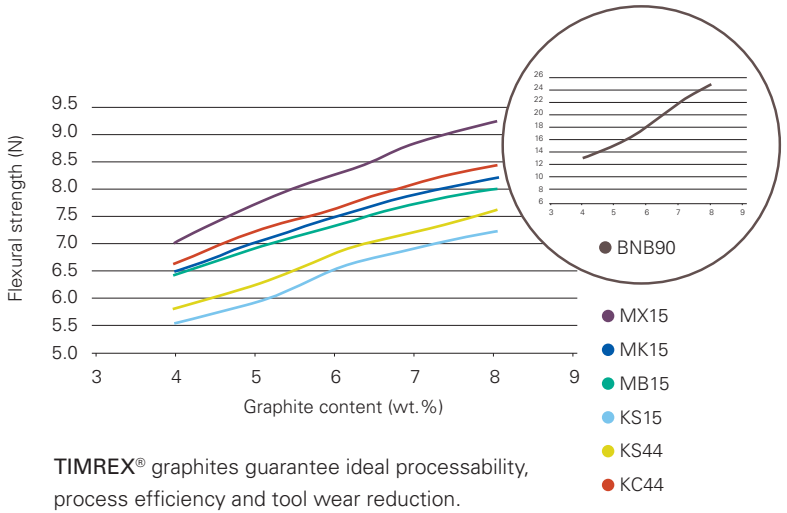
OUR SOLUTIONS

PRODUCT LINES	CHARACTERISTICS	APPLICATION BENEFITS
KS Primary Synthetic Graphite	✓ Crystalline graphite agglomerated into particles ✓ Controlled texture and porosity ✓ High electrolyte absorption capacity ✓ Mildly anisotropic	✓ Intrinsic electrical conductivity ✓ Optimal electrolyte penetration in the electrode ✓ Ideal ionic contact of the EMD particles ✓ Good processability
MB, MK, MX & KC Primary Synthetic Graphite	✓ High crystalline flake graphites ✓ Extremely anisotropic ✓ Optimized compressibility ✓ Excellent lubricating properties	✓ Very high electrical conductivity ✓ Designed to allow for a high EMD/graphite ratio to optimize energy and power density ✓ Excellent processability ✓ High performance to price ratio
BNB90 High Aspect Ratio Graphite	✓ Premium grade high purity high aspect ratio graphites ✓ Two-dimensional particle shape ✓ Unique texture and morphology	✓ Excellent electrical conductivity with very low percolation thresholds ✓ High mechanical stability ✓ High energy density ✓ High current drain

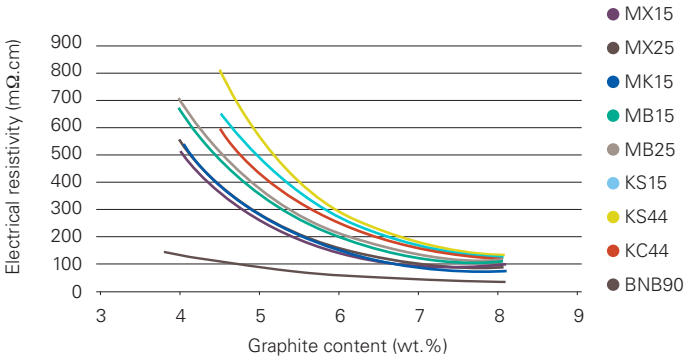
TIMREX® PRIMARY SYNTHETIC POWDERS & HIGH ASPECT RATIO GRAPHITES

PERFORMANCE DATA

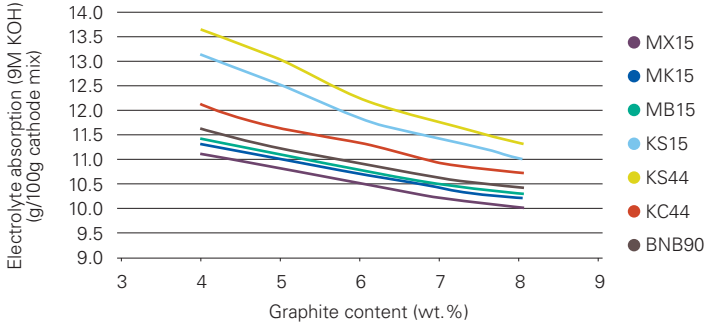
Imerys Graphite & Carbon's broad range of specialized graphites allows us to help each manufacture to find the ideal solution for their particular production process and battery application performance requirements.



TIMREX® graphites guarantee ideal processability, process efficiency and tool wear reduction.



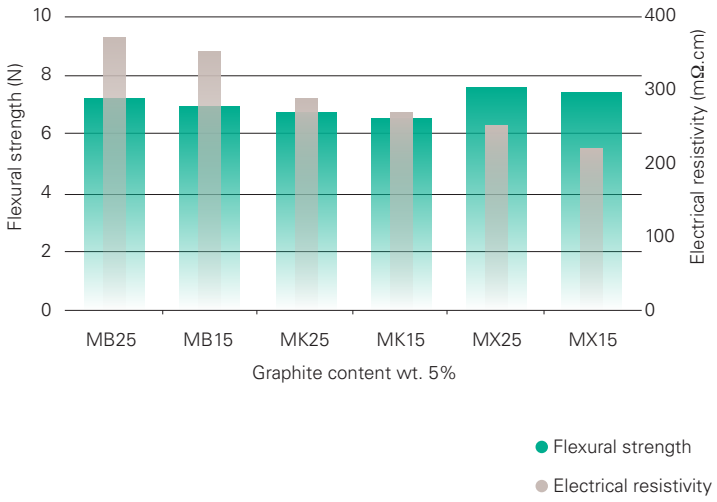
TIMREX® specialized graphites have been specifically developed to be used at low loading levels, allowing for a higher EMD/graphite ratio in the cathode mix to achieve the optimal level of resistivity.



TIMREX® graphites improve electrolyte absorption optimizing electrochemical charge and discharge performance.

OPTIMISE YOUR CATHODE MIX

Our wide portfolio of products allows customers to find the optimal solution with respect to the resistivity, flexural strength and price of their unique cathode mix.



Our premium **TIMREX**® BNB90 high aspect ratio graphite is designed for cathodes with low graphite content.

Manufactured with a sophisticated process unique to Imerys Graphite & Carbon resulting in a two-dimensional particle shape that ensures very high electrical conductivity in the cathode mix with a very low percolation threshold and strong mechanical stability at low loadings.

TIMREX® GRAPHITE DISPERSIONS

SOLUTIONS FOR CAN COATINGS

TIMREX® LB aqueous dispersions are designed to improve electrical conductivity and the discharge capacity of alkaline batteries.

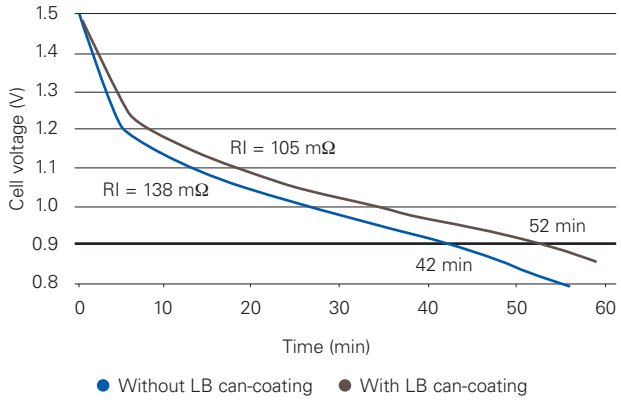
Applied to a nickel or cobalt plated steel can by spraying, dip-coating or brush-painting, they form a thin chemically inert, electrically conductive layer which adheres well to specific substrates.

Recommended for High-drain AA, AAA, C & D batteries.

Key benefits include:

- Environmentally friendly, compared to solvent dispersions
- Low volatile organic compound ensures safe processing
- Improved electrical conductivity
- Improved discharge capacity

Discharge voltage profiles



Test configuration:

Cell Size: LR14 (C)

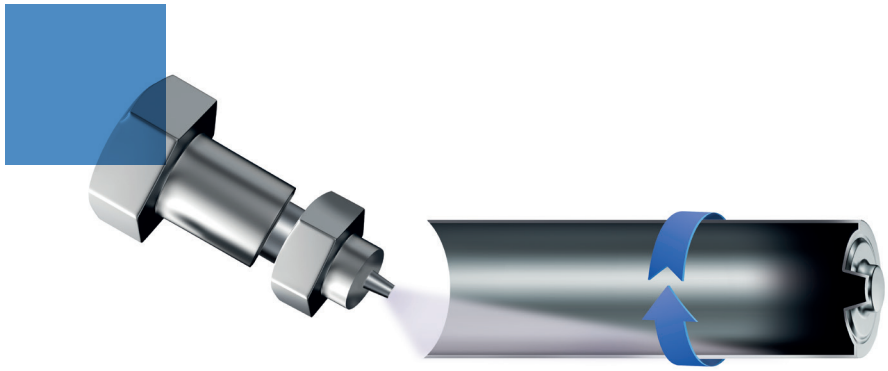
Cathode: 1 MnO_2 / **TIMREX®** MX15 cathode ring re-compacted into the can; compaction pressure: 3 t/cm²

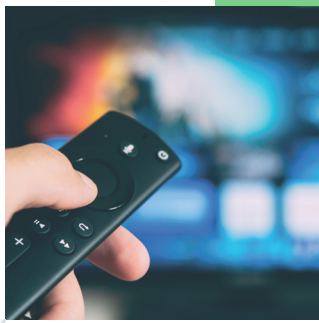
Graphite content: 5%

Discharge capacity: 67 mAh/g MnO_2

Cell voltage: 0.9 V

Temperature: 20 °C





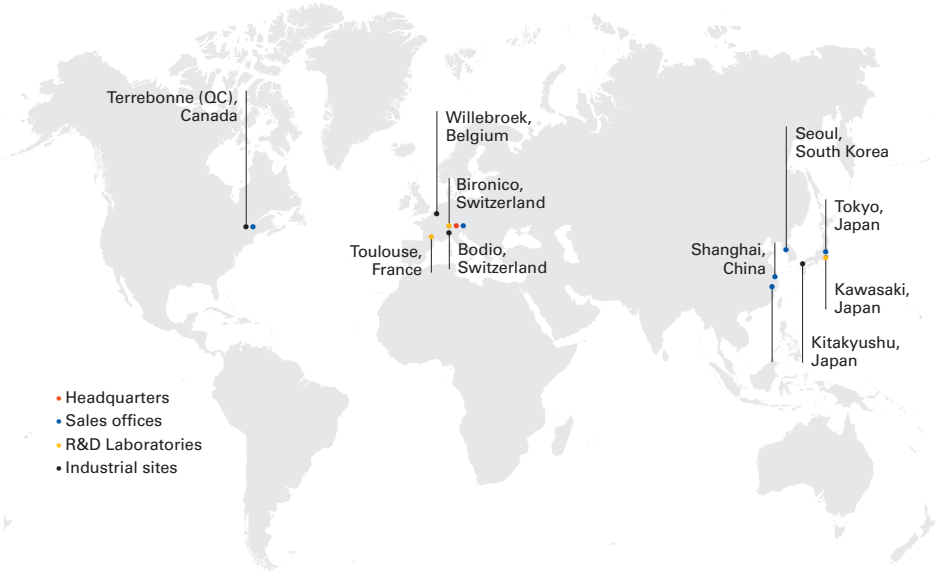
PRODUCT RECOMMENDATION

Application-related properties of TIMREX® graphite conductive additives and can-coating dispersions.

GRAPHITE GRADE	PARTICLE SIZE, D90 (µm)	PARTICLE SHAPE	ASH (%)	SCOTT DENSITY (g/cm³)	SPECIFIC BET (m²/g)	RECOMMENDED GRAPHITE CONCENTRATION	BATTERY TYPE
KS15	17	Isometric, irregular spheroids	0.05	0.10	12	7 – 9%	Standard AA, AAA & Button cells
KS44	45	Isometric, irregular spheroids	0.06	0.19	9	7 – 9%	Standard C & D
KC44	48	Anisometric, flakes	0.05	0.19	7	6 – 8%	High-drain C & D
MB15	18	Anisometric, flakes	0.06	0.09	9.5	6 – 7%	High-drain AA & AAA
MB25	27	Anisometric, flakes	0.06	0.11	8	6 – 7%	High-drain AA, AAA, C & D
MK15	15	Strongly anisometric, flakes	0.03	0.07	10	5 – 6%	High-drain AA & AAA
MK25	22	Strongly anisometric, flakes	0.03	0.09	8	5 – 6%	High-drain AA & AAA
MX15	17	Strongly anisometric, flakes	0.05	0.065	9.5	4 – 6%	High-drain AA & AAA
MX25	25	Strongly anisometric, flakes	0.05	0.065	9.5	4 – 6%	High-drain AA & AAA
BNB90	105	Strongly anisometric, 2-dimensional	0.14	0.03	28	3 – 5%	High-drain AA & AAA
LB family	Aqueous graphite dispersions						High-drain AA, AAA, C & D

Typical values

IMERYS GRAPHITE & CARBON – A STRONG, INNOVATIVE COMPANY.



With production sites in Europe, Canada and Japan and sales offices in Europe, America and throughout Asia we can ensure security of supply and an optimal customer experience.

OUR EXPERTISE

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
- Fuel Cells
- Conductive Polymers, Plastics and Rubbers
- Carbon Brushes
- Brake Pads and Clutches
- 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
- Graphites for resin bonded carbon brushes
- Conductive 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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