# SPECIALTY CARBONS FOR SINTERED FRICTION MATERIALS

TIMREX®TIMREX®TIMREX®GraphiteC-THERM™CokeGraphiteGraphite







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

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#### **INNOVATIVE LEADERSHIP**

Innovative leadership and competence make Imerys Graphite & Carbon the right partner for the development and optimization of solutions for sintered friction materials.

Imerys Graphite & Carbon has been serving this market for decades, always adapting to new industry requirements and developments. Close collaboration with customers allows us to tailor graphite based solutions that optimize their particular friction material formulation. Our proprietary production processes give full control over key product parameters such as purity, crystallinity, particle size distribution, and oversize control ensuring consistency and reliability of the customers final product.



# IMERYS GRAPHITE & CARBON SOLUTION FOR SINTERED MATERIALS

#### CUSTOMIZABLE SOLUTIONS

We work closely with customers to deliver tailormade solutions for friction material applications with superior consistency of key product parameters: purity, crystallinity, particle size distribution, and oversize control.

Final applications for sintered friction materials include:

- 𝔄 High speed trains
- 𝔅 High-performance motorcycles
- ${}$  Wind turbines
- 𝔄 Aircrafts
- 𝔄 Other industrial equipment
- 𝔄 Off-road vehicles

KEY PERFORMANCE REQUIREMENTS (OF BRAKE PADS)	RELATED GRAPHITE PROPERTIES	RECOMMENDED GRADE
Consistent compressibility, compaction of powder mix, and processability	Low spring back and tailored particle size distribution (PSD)	TIMREX® KC150-600
Good sintering	Tailored PSD and graphite morphology	TIMREX® KC150-600 TIMREX® KS500 TIMREX® KS150-600 SP
Good mechanical properties	Tailored PSD	TIMREX® KS150-600 SP TIMREX® KC150-600
Low swelling	Low thermal spring-back	TIMREX <sup>®</sup> KC150-600 TIMREX <sup>®</sup> C-THERM™
Low wear	High thermal conductivity and tailored PSD	TIMREX <sup>®</sup> KC150-600 TIMREX <sup>®</sup> C-THERM™ TIMREX <sup>®</sup> KS500
High brake energy	High friction coefficient	TIMREX® KS500 TIMREX® KC150-600 FC Coke

Test results presented in this brochure have been obtained in copper-sintered motorbike formulations containing ca. 8% graphite (in collaboration with SBS Friction A/S)





# **KEY BENEFITS**

#### COMPRESSIBILITY OF DIFFERENT GRAPHITE GRADES

Compaction of powder mixes generates plastic deformation of particles, with a partial recovery of compaction energy (elastic spring-back). Spring-back can lead to lower density, cracks and increased scrap rate in production.

We offer tailored solutions with consistent compressibility and easy processability. TIMREX<sup>®</sup> KS synthetic graphite has much higher spring-back compared to natural graphite, while TIMREX<sup>®</sup> C-THERM<sup>™</sup> and TIMREX<sup>®</sup> KC have intermediate spring-back values. Spring-back is strongly dependendent on particle size and increases with increasing particle size distribution (PSD).

The spring-back of copper-based powder mixes follows the same trend as graphite powders.







# **KEY BENEFITS**

#### **GOOD SINTERING**

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Our production processes allow for the highest control of particle size distribution and morphology enabling us to customize solutions to meet the specific needs of our customers. Different graphites have different morphologies: natural graphite is very flaky and anisotropic, whereas TIMREX<sup>®</sup> KS primary synthetic graphites are more spheroidal and isotropic. TIMREX<sup>®</sup> KC graphites have intermediate anisotropy.

The density increase after sintering is higher for coarse graphites, therefore indicating better sintering compared to fine graphites.



Metallography of sintered brake pads containing 8% graphite.

TIMREX<sup>®</sup> KS75



TIMREX<sup>®</sup> KS150-600



TIMREX<sup>®</sup> KC150-600



#### Density increase green - sintered



#### **CONTROL OF MECHANICAL PROPERTIES**

The hardness clearly increases with increasing graphite particle size and the highest hardness values are obtained with TIMREX<sup>®</sup> KC 150-600. A similar trend is observed for the shear strength. This is due to the higher sintering quality when using graphites with larger particle sizes.



Hardness of sintered brake pads containing 8% TIMREX® graphite



Strength of sintered brake pads containing 8% TIMREX<sup>®</sup> graphite

# **KEY BENEFITS**

#### IMPROVED THERMAL CONDUCTIVITY AND REDUCED SWELLING

Safe friction materials must be able to maintain thermal stability in the severest of braking conditions in order to prevent the dangerous phenomenon of deformation or cracks in the brake pads and fading.

TIMREX<sup>®</sup> KC150-600 graphite is able to maintain low swelling at high temperatures. Low swelling prevents cracks and deformation in brake pads, even in extreme conditions.

Brake pads with **TIMREX<sup>®</sup> C-THERM<sup>™</sup>** show the highest in-plane thermal conductivity which minimizes hot spots and tensions cracks.





High in-plane thermal conductivity minimizes hot spots and tension cracks.

In-plane (darker)

Through-plane (lighter)

Thermal expansion of sintered brake pads containing 8% TIMREX<sup>®</sup> graphite (dilatometry tests in nitrogen atmosphere)



- TIMREX® KS150-600 SP - TIMREX® KS500 - TIMREX® KC150-600



#### WEAR RESISTANCE

Brake pad wear increases with decreasing particle size of graphite.

Brake pads containing 8% TIMREX® graphite

#### **STABLE FRICTION COEFFICIENT**

TIMREX<sup>®</sup> C-THERM<sup>™</sup> is proven to stabilize the friction coefficient at high values (> 0.55) as demonstrated in the figure below.

The friction coefficient increases with increasing particle size.



#### Friction coefficient of sintered brake pads containing 8% TIMREX® graphite





# **IMERYS GRAPHITE & CARBON PORTFOLIO OF SOLUTIONS FOR SINTERED BRAKE PADS**





Primary synthetic graphite with higher compressibility



Calcinated petroleum coke

# IMERYS GRAPHITE & CARBON PORTFOLIO OF SOLUTIONS FOR SINTERED CLUTCHES





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