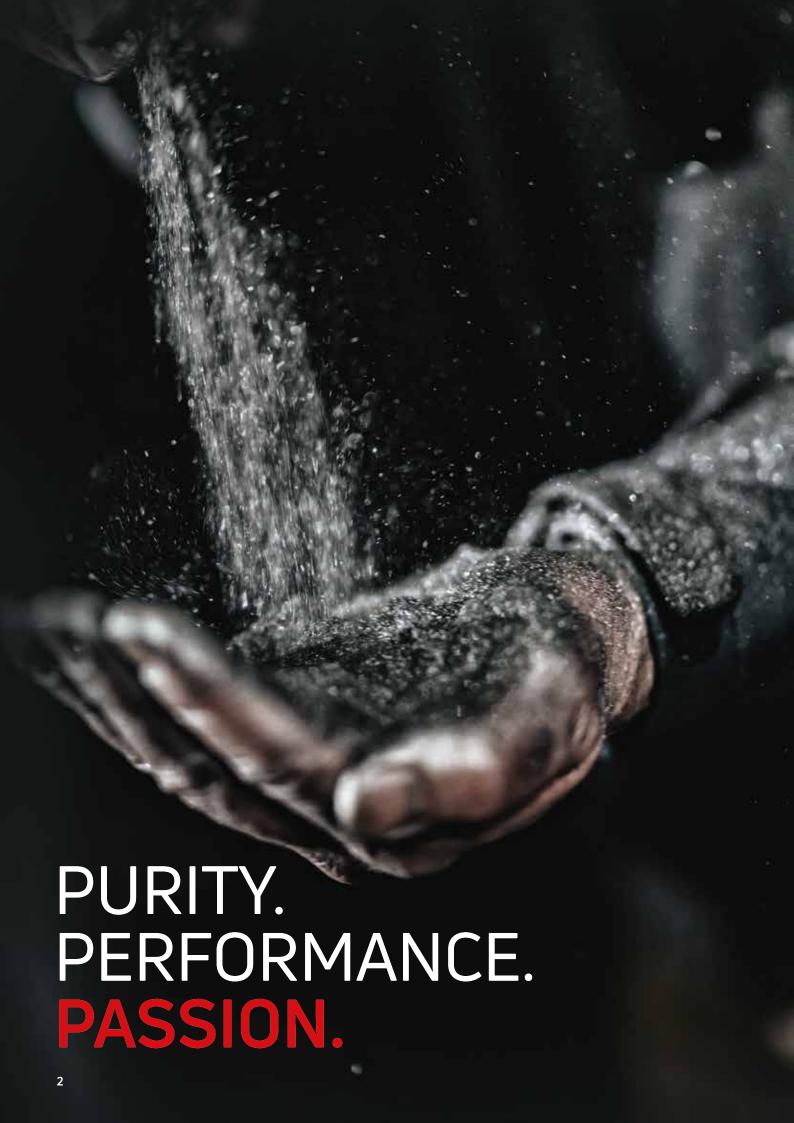


PURITY. PERFORMANCE. PASSION.

RAW MATERIALS EXPERT FOR OVER 100 YEARS



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AMG GRAPHITE

Over 100 years of expertise.

Since its establishment more than 100 years ago, AMG Graphite has been synonymous with outstanding raw materials expertise – and production sites across three continents. In addition to the extraction of natural graphite, we have also specialised in the production of various high-quality graphite products. Innovation, proximity to markets and an unwaveringly customer-centric approach have made us a trend-setting graphite refiner.

We guarantee the highest quality based on state-of-the-art processes from raw material to custom solutions developed in close dialogue with our customers. Our clear commitment to research work ensures the continuous optimisation of our product portfolio. AMG Graphite operates its own mines at its headquarters in Kropfmühl, Germany and in Sri Lanka.

Since 2008, AMG Graphite has been part of AMG Critical Materials N.V. and, as a global expert in critical raw materials, it is at the cutting edge when it comes to technologies and high-quality products for reducing CO_2 emissions.



employees



mines on 2 continents



years of experience

AMG GRAPHITE

Milestones

Graphite has been mined in the region around Kropfmühl for some 2500 years. The Celts already used the ore to produce fire-resistant and waterproof pots. As the Celts moved on, so did their knowledge of extracting and refining graphite in the Bavarian Forest. And it wasn't until the Middle Ages that farmers once again began to intensively look into the shiny grey material once more and excavate earth containing graphite in their fields.





1870 | Company founded

Rural graphite extraction begins in the Lower Bavarian Forest.

1871 | Industrialisation in Kropfmühl

Industrial graphite mining commences in Kropfmühl. Mining becomes a key industry in Germany.

1916

1916 | Transition into a public limited company

Anna and Max Langheinrich, Ownership of the Kropfmühl pit since 1908, found Graphitwerk Kropfmühl AG.











1930 | Interest from large German corporations

Industrial interest from major German corporations such as Thyssen Krupp and Rütgers in graphite from Kropfmühl

1946 | Decommissioning of the graphite plant

Graphite operations are shut down after the constant expansion of the plant from 1939 onwards due to the importance of graphite for the defence industry.

1955 1955 1955

From 1955 | Modern process tech rolled out

Use of modern process technology to obtain high degrees of purity. Search for graphite deposits worldwide.

1965/67 | Joint

venture in Zimbabwe

Development of a deposit in Rhodesia (now Zimbabwe) as part of a joint venture with a domestic partner. Opening of a plant in Wedel near Hamburg for the storage and processing of imported raw materials.

1980s | Acquisition of Edelgraphit

Acquisition of the graphite-based lubricant and separating agent manufacturer Edelgraphit GmbH in Bad Godesberg and expansion of the fine milling system at the Kropfmühl plant.

1997 | IPO

Graphit Kropfmühl AG goes public.









1999 | Expansion in Czech Republic and Sri Lanka

Acquisition of Graphite Týn and investment in the Bogala Mine in Sri Lanka.

2002 | Development of SGB Graphite

Establishment of a competence centre for graphite at the Kropfmühl site parallel to the expansion of the research and development department.

2008 | AMG N.V. acquires 80% of GK shares

AMG Advanced Metallurgical Group N.V. acquires 80% of the shares in Graphit Kropfmühl AG.







2012 | Full acquisition of Graphit Kropfmühl AG by AMG and reopening of the mine in Kropfmühl



2016 | Reactivation of a mine in Mozambique

Roll out of high-tech mills and reactivation of a decommissioned graphite processing plant in Mozambique.

20<u>7</u>02

2018 | Investments in Kropfmühl

Expansion of production capacities and forward-looking investments at the Kropfmühl site.

2020 | Dispersion plant in Kropfmühl

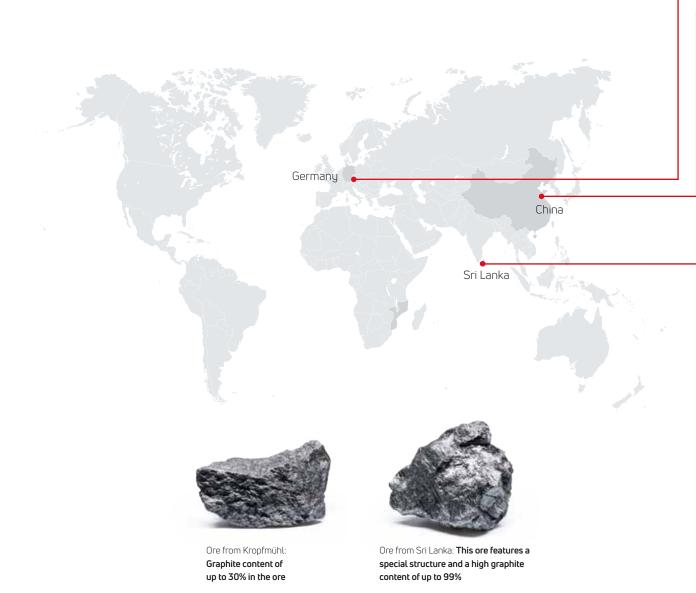
Expansion of the dispersion product segment through the construction of a production hall and enhancement in capacity.



The ore helped many farmers achieve considerable riches. The industrial revolution at the beginning of the 19th century, however, transformed agricultural Germany into an industrial state and saw rural graphite mining replaced with professional extraction operations. In the same year as the establishment of the German Empire in 1871, AMG Graphite was born.

Locations worldwide

To ensure a consistent supply of raw materials, we operate in Europe and Asia. The head office of the company is located in Kropfmühl, Germany.





Germany

Graphit Kropfmühl GmbH is headquartered at the company's founding location in Kropfmühl near Passau. In Kropfmühl, graphite is mined underground and refined using modern milling and purification plants. In addition, ready-to-use lubricant mixtures in powder form and dispersions are also prepared on site. The Kropfmühl site is also home to the Group's research and development centre.



China

Qingdao Kropfmühl Graphite Co. Ltd. (QKG), located in eastern China, focuses on the refinement of natural graphite and the processing of synthetic and expandable graphite. Moreover, QKG also serves as a procurement centre for various graphites within the group.



Sri Lanka

At Bogala Graphite Lanka plc. in Sri Lanka, high-quality ore is mined underground. This special vein graphite is purified, sieved and milling site for the world market. In addition, graphite dispersions are also produced here for the Indian and Asian markets.

AMG Critical Materials N.V.

AMG Group

As a global specialist for critical raw materials, AMG Critical Materials N.V. leads the way when it comes to technologies and high-quality products designed to reduce carbon dioxide emissions.

The AMG Group produces advanced specialty metals and mineral products, and also offers vacuum furnace systems and services. With around 3,400 employees worldwide, the company serves international customers in the transport, infrastructure, energy, specialty metals and chemicals sectors. Using metallurgical-based solutions developed for industry, the AMG Group meets the growing demand for energy saving and resource conservation, and develops advanced products and technologies for a wide variety of applications.

Critical raw materials worldwide





Si - Silicon

Ta – Tantalum

Cr - Chromium

Ni - Nickel

Ti – Titanium

C - Graphite

Li - Lithium

Al – Aluminium

Nb - Niobium

Sb - Antimony

V - Ferrovanadium







countries

CO₂

million tons of CO₂ saved

1.64 billion

Dollars in sales in 2022

public limited company founded

15

GRAPHITE - THE ALL-ROUNDER

The sixth element



Carbon — Graphite — Microcrystalline natural graphite — Diamond — Macrocrystalline natural graphite — Fullerene — Synthetic graphite —

A chemical powerhouse

In the classical periodic table, the mineral graphite is placed in sixth position. Graphite can be characterized by six parameters that are related and also influence each other: Purity, crystallinity, particle size, particle shape, surface and porosity. When processing graphite, these parameters can be precisely influenced. This helps achieve the optimum combination of properties for the respective application.

Lubricating

Graphite is an excellent lubricant due to the large spacings between layers in the crystal lattice, combined with low binding forces.

Intercalable

Intercalation describes the storage of atoms, ions or small molecules between crystal lattice planes. As a so-called layered crystal, graphite has this property.

Acid and alkaline resistant

Graphite is considered to be particularly resistant to non-oxidised acids and alkalis. This means that it does not dissolve in them.



Temperature-resistant

Due to its excellent degree of crystallization, graphite is resistant to oxidation and temperature changes as well as resistant to most chemical agents.

Conductive

Expandable

Graphite owes its thermal and electrical conductivity to its free electrons, so-called valence electrons.





02 FLOTATION



In order to enrich graphite as a concentrate, the crude ore is wet extracted and subjected to flotation. This process separates the graphite from other minerals by wet mechanical means to increase the carbon content up to roughly 96 percent. In the late 19th century, the flotation process in Kropfmühl was patented and used commercially for the first time – and has been continuously optimized in the years since.

O3 SIEVING & MIXING



After wet mechanical processing, the concentrate is dewatered, dried and sieved. The graphite is separated into different fractions and, if necessary, homogenized by mixing.

04 MILLING



After purification, the raw material is milled to different grain sizes – some of the graphites even to fineness grades of less than 2 µm in average grain size. Different milling processes influence the particle morphology, optimise the particle size of the concentrate and give the graphite the desired shape.

Value creation process – Everything from a single source

We process crude ore into high-quality graphite and develop products for specific applications – always in step with the wishes of our customers.

The mined ore is first purified in the so-called flotation process. Afterwards, we screen off different particle sizes or mill the graphites into different grain sizes – based on the intended application and requirements. If a higher carbon content is required, we clean the graphite using a chemical or thermal process.

In addition to its carbon content, the distribution of particle sizes is also an indicator of the quality of the graphite. Tailored processing steps help us to produce the smallest fractions. AMG Graphite is constantly continuing the development of its graphite refinement process – and the company works closely with leading research centres and universities worldwide to this end.

05 PURIFICATION



Further processing steps are necessary after flotation for highly pure varieties with a substantially higher carbon content. In the chemical purification process, the carbon content of the graphite is increased further and a purity of more than 99 percent is achieved. Thermal purification even makes purity levels of up to **99.99** percent possible.

O6 PACKAGING & LOGISTICS



Protecting the environment is our primary goal. That is why we place a clear focus on sustainability in packaging. We enter into dialogue with our customers to find the best transport solution from an environmental standpoint. By using silo trains, we save large amounts of resources and thus make an important contribution to protecting our planet.



Tailored to your needs

AMG Graphite extracts and refines natural graphite, processes and refines synthetic graphite, and produces dispersions, pastes and lubricant premixes in powder form. We offer products on both a customer-specific and application-specific basis – with the highest quality always delivered as standard. Thanks to our own controlled raw material sources in Asia and Europe, we can guarantee our customers and partners the highest security of supply and provide graphite grades for every requirement and field of application.





Natural graphite powder



Natural graphite flakes





Synthetic graphite



Expandable graphite







Graphene

ADVANCED

Powder

Natural graphite powder

AMG Graphite offers purified and milled graphite powder in a variety of grain sizes. The smallest particles in the high-purity natural product are in the lower single-digit micrometre range and are used for special applications.



Natural graphite flakes

Natural flake graphite can be used universally and, depending on the flake size and carbon content, it is suitable for a wide variety of applications. Expandable graphite can be produced from large graphite flakes. In addition, the flakes can also be found in refractory moulds, seals and friction linings. Small-flake graphite, on the other hand, is used as a lubricant or for carburizing steel and foundry products.



Vein graphite

The unique vein graphite produced in our own mine in Bogala can be combined particularly easily. It is used as a component of battery cells, carbon brushes, in powder metallurgy, plastic applications, refractories or lubricants: "Vein graphite" is so called because it runs through the rock like veins.



Synthetic graphite

Graphite can also be produced synthetically. The carbonization of carbonaceous materials produces so-called "graphitable carbons", which stem from lignite, hard coal, petroleum, pitches. AMG Graphite offers synthetic graphite as an additive for brake and friction linings, among other uses.



Dispersion

Water-based

In order to produce graphite dispersions, very finely milled graphite particles are dispersed in a liquid. This liquid is often water. Dispersions with fine-grained graphite improve forging operations and are used in the warm and hot forging process, while coarser-grained graphite dispersions withstand the high temperatures created by the lubrication of mandrel bars and rollers. They also serve as separating agents in the casting and moulding of metals.



Oil-based

Oil-based graphite dispersions optimise performance and properties across a range of applications. If, for example, they are added to a mineral or synthetic oil, they improve the emergency running properties of technical parts. In addition, oil-based graphite dispersions impregnate various materials and ensure conductivity in the material matrix.



Powder premix

AMG Graphite offers tailored solutions for the needs and requirements of its customers – and therefore not just "ready-to-use" graphite dispersions, but also powder mixtures. These are dispersed with special high-performance mixers shortly before use, e.g. for the hot forming of metal.



Advanced

Expandable graphite

The layered lattice structure of graphite enables the intercalation of atoms or small molecules between the carbon layers. This results in so-called expandable salt or GIC (Graphite Intercalation Compound). High-quality expandable graphites have a high proportion of intercalation layers, with the molecules incorporated generally being sulphur or nitrogen compounds. One of the most important applications of expandable graphite is its use in flame retardants.



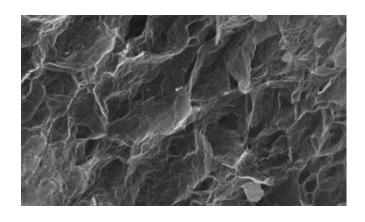
Expanded graphite

Under the influence of heat, the layers of the material unfold like an accordion, and the graphite flakes expand. Depending on the material, the expansion already begins at 180 °C and takes place suddenly and quickly. If the flakes can expand freely, their final volume is several hundred times greater than the original volume.



Graphene

While carbon already offers a wide range of applications in the form of graphite and diamond, the two-dimensionally structured modification "graphene" extends the portfolio of extremely stable carbon materials even further. Single-layer carbon films were discovered by the English chemist Benjamin Collins Brodie in the mid-19th century, but the great potential of graphene was only truly uncovered by the Russia physicists Konstantin Novoselov and Andre Geim – netting them the 2010 Nobel Prize in the process.





You can also browse our product portfolio on our website: www.gk-graphite.com/products

A VARIETY OF APPLICATIONS

Made to tackle tough tasks

Graphite is a true all-rounder. Whether in plastics, in electric motors, brake linings and insulating material, in paint or pencil lead – graphite is everywhere you look. AMG Graphite is already working today on the products of tomorrow, collaborating closely with its customers and partners on finding made-to-measure solutions for the future.

Areas of application

Automotive industry Chemicals industry



- Battery
- Carbon brush
- Powder metallurgy
- Forge
- Brake pad
- Seal/gasket
- Lubricant



- Plastic
- Compound/masterbatch
- Functional filler
- Contract manufacturing
- Additive

Construction industry



- Fire protection
- Thermal insulation
- Paint and varnish

Traditional applications



- Pencil
- Refractory/crucible
- Seamless pipe
- Casting
- Carbide sintering



Trading and more



- Special applications
- Trade



Graphite-based solutions will play an increasingly central role in the automotive industry in the future.

01 E-Mobility

Graphite is used to produce innovative energy storage and conversion systems. It is the anode material of choice in modern lithium-ion batteries when it comes to energy storage capacity, cycle stability and cost efficiency.

03 Conductivity

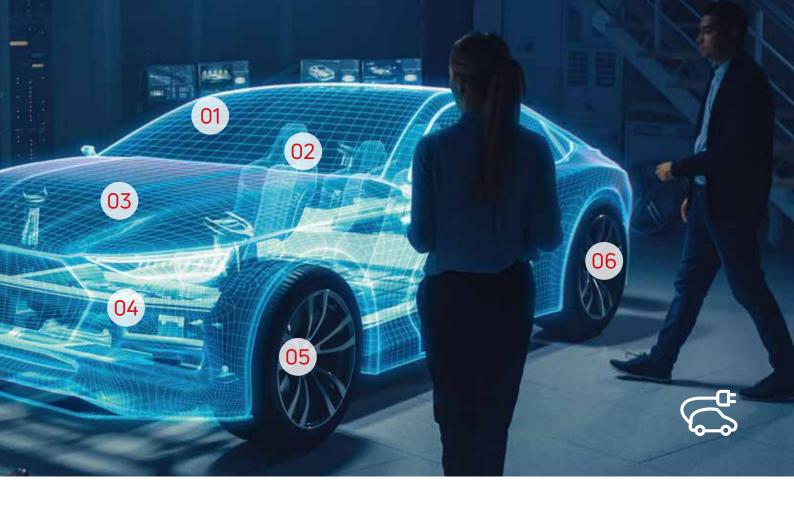
Free electrons make graphite both electrically and thermally conductive – with the size and structure of the crystallites decisive in this regard.

02 Fire protection – Foam, plastics, textiles

Expandable graphite is a flame retardant additive: When heat is applied to the material, the graphite expands and swells to create a protective layer on the surface. In addition, combustion gases are trapped and prevented from penetrating the material.

04 Lubricants - Grease, oil additives

Graphite keeps things running smoothly: The particles slide easily on top of each other and reduce friction. As graphite neither binds to dirt nor becomes resinous, it is used for lubricating greases and at lubrication points subject to high thermal stress.



05 Brake and clutch pads

Due to its excellent lubrication properties, graphite modulates the braking effect of friction linings, enabling comfortable braking and minimizing noise. In addition, the thermal conductivity also makes graphite an important material in the production of brake and clutch linings.

06 Chemistry – Tyres, acoustic insulation board

In many cases, several different graphite properties work together and cannot be categorized individually. This once again underlines the strength of graphite – e.g. as an additive in rubber, adhesives, paints and varnishes, master batches and compounds.



Further areas of application are outlined on our website: www.gk-graphite.com/applications



Flame retardant

Flame retardants are intended to limit, slow or prevent the spread of fires. Whether in upholstered furniture, car seats or carpets – flame retardants are used wherever there are potential sources of fire. Expandable graphite is particularly well suited for use as a flame retardant additive: When heat is applied to the material, the graphite expands and swells to create a protective layer on the surface, slowing the spread of the fire. Moreover, by sealing cavities, e.g. by using sleeves containing expandable graphite (pipe closing systems), the material stops combustion gases which would otherwise penetrate the material.



Paint

Graphite offers real added value in many applications. That's why this shiny black material is found in numerous formulations used in the paint and varnish industry as a corrosion protection pigment. Since graphite is oxidation-resistant, temperature-stable, lighter than many metals and also environmentally friendly, it is also frequently used in shipbuilding, among other things. As every minute counts at sea, the direct supply of high-quality coating materials is essential. As a result, AMG Graphite products help protect floating assets under the toughest conditions, and also contribute to reducing fuel consumption and preventing fouling in shipping.





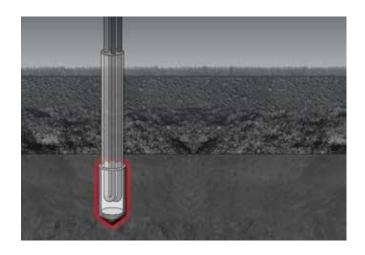
Thermal protection

Modern graphite technology makes the most efficient insulation material even better: Graphite particles are incorporated into the foam structure of white expanded polystyrene (EPS), which not only turns the insulating material grey, but also adds graphite's ability to reflect infrared radiation and heat. Grey EPS increases insulation performance by up to 20 percent and is suitable for buildings with a high energy standard as well as existing buildings looking to achieve the best insulation results with limited space.



Your advantages

When embedded in filling material made of natural graphite, the thermal contact between the sensor head of the geothermal probe and the surrounding soil is guaranteed. Through the use of natural graphite, outstanding thermal conductivity levels are achieved.





Contract manufacturing

When an application requires the uniform and fine distribution of graphite on the surface of a material requiring a coating, graphite dispersions are often used. Depending on the application, they should be stable in the sediments and should take into account the surface tension, the wetting behaviour and adhesion capacity, the drying time, viscosity and the pH. Graphite dispersions which, in addition to graphite and water also contain protective colloids, preservatives and various other additives in order to improve the dispersion, can be prepared individually for each application. In addition to tailor-made dispersions, AMG Graphite also offers powder premixes that users can mix with water themselves.



Special applications

In addition to the further development and enhancement of existing graphite dispersions, AMG Graphite also creates novel dispersions for use in special applications. Thanks to the special properties of graphite, our innovations are spreading into a wide range of technological fields and delivering on the desired properties and functions of products – which include, among other things, the electrical and thermal conductivity and high chemical, thermal and mechanical resistance of graphite coatings.





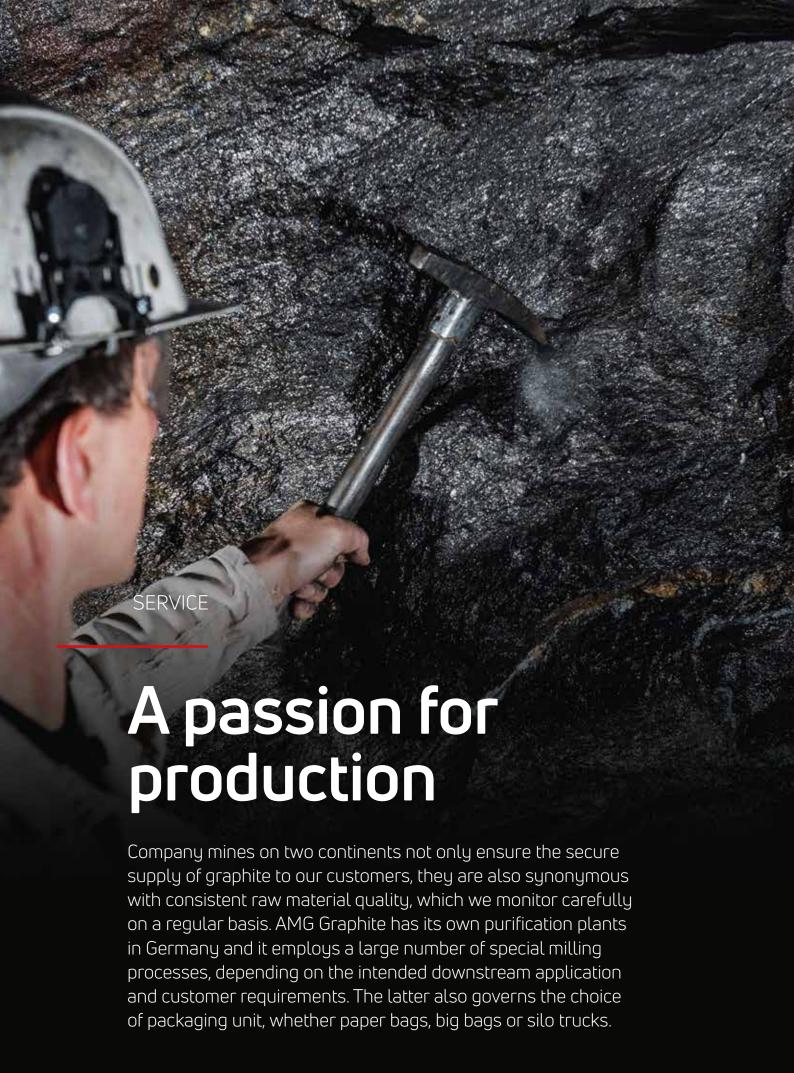
Additive/functional filler

Demand is steadily increasing for plastic applications with good mechanical properties coupled with heat-conducting abilities. Specially selected or modified graphites provide powerful additives for precisely this purpose. Depending on the requirements of the applications, different graphite-based filler concepts can provide optimal results. If only very low conductivity is permitted, graphite is used in low filling rates. Thanks to its thermal conductivity, graphite also fulfils a wide variety of thermal management tasks.



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Mining

The majority of the raw materials for the AMG Graphite products come from company mines. Thanks to secure raw material sources in Asia and Europe, we can guarantee our customers the optimal security of supply with consistently high product quality.

Flotation and milling

In order to enrich graphite as a concentrate, the crude ore is wet extracted and subjected to flotation. This process separates the graphite from other minerals by wet mechanical means in order to increase the carbon content to around 96 percent. After the graphite prepared in this way has been dewatered, dried and sieved as well as separated into different fractions, the refined raw material is milled to different grain sizes – with some of the graphites going down to sizes of less than 2 micrometres. Different milling processes influence the particle morphology, optimise the particle size and give the graphite the desired shape.

Chemical and thermal purification

Further processing steps are necessary after flotation for products with a graphite content of more than 96 percent. In the chemical purification process, the carbon content of the graphite is increased once again and a purity of more than 99 percent is achieved. Chemical-thermal purification even makes purity levels of up to 99.99 percent possible.









Supply chain management

Industrial processes require complete transparency and the maximum possible customisation. AMG Graphite delivers everything from one single source, manages and controls all process steps and can draw on many years of experience and expertise in the international graphite business. Our services unlock new value creation potential along the entire production and supply chain, increasing operational efficiency, product quality and profitability. We offer our customers and partners a unique and consistent range of identification and localization systems for all products and processes. Our Chinese subsidiary QKG strengthens the raw materials network in Asia, ensures the selection and monitoring of suitable graphites and operates in step with German quality standards.

Innovation

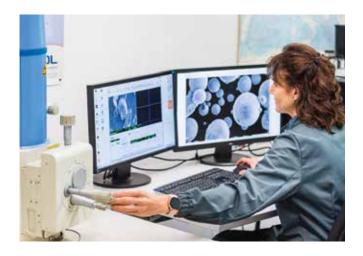
Graphene, film-thin 2D crystals consisting of only one layer of carbon atoms, has the potential to revolutionize microelectronics and computer technology thanks to its supreme electrical conductivity. If screens and mobile phones can soon be folded like a newspaper, if cars can drive by themselves, planes weigh only a few kilos and people can soon jet off to Mars, then graphene will be playing its part – and the product world of AMG Graphite will be at the forefront of this development. And graphene is just one of many innovations that we are committed to developing. Open to any new development, we are the ideal raw material partner for forward-looking ideas across all industries. In this role, we work with our customers on ground-breaking innovations and help to patent ideas.

Technical consulting

Thanks to our large standard product range, AMG Graphite is able to respond to any requirement in a customer-oriented and flexible manner – this is our core competency. In order to offer our customers and partners the best solutions, precise knowledge of their processes, use cases and final applications is required. Thanks to our diverse product portfolio and decades of experience in a wide range of industrial sectors and fields of application, we are well placed to provide our customers with outstanding technical advice.

Research and development

AMG Graphite ensures the continuous optimisation of its product portfolio with extensive research and development work. AMG Graphite stands out as a leading technological company by virtue of its constant intensive work with new processing techniques and the development of special graphite products for modern applications. By cooperating with universities and research institutions on a regular and long-term basis, we transfer comprehensive know-how and adopt a leading role in pioneering projects.





RESPONSIBILITY

Shaping the future

Driven by an innovative and sustainable approach to business, we help secure a high quality of life for generations to come – focussing on what really matters. One notable focus of our daily work is the transition to greener energy and raising awareness for saving resources. AMG Graphite uses materials and technologies designed to minimise carbon dioxide emissions. We are setting standards in this regard. Protecting the climate. And shaping the future.



Environmental protection

Environmental protection is a primary objective of our corporate policy. All employees are therefore regularly trained in how to conserve resources in their work as well as in any specific aspects for their role within the company. No production waste is produced when graphite is processed. All by-products created are in turn used as raw materials in other formulations and added to a closed production cycle.





Occupational safety

Occupational health and safety are important components of our corporate strategy to achieve our corporate goals. Sustainable corporate success not only demands that the performance capacity and motivation of our employees be maintained, but also strengthened further. Protection measures and safe conditions for properly fulfilling tasks are guaranteed and implemented for every single employee at the highest level.







Quality assurance

For us, quality is the result of a systematic, continuous process. Our aim is not only to keep our promises, but to exceed them to the satisfaction of our customers and partners. The quality of our products and services is the decisive factor in determining the success and competitiveness of our company. To ensure quality assurance and optimisation, we aim to train our staff as optimally as possible and actively involve all employees in the improvement process.



Our certificates

Occupational safety management

ISO 45001 since 2014

Quality management

ISO 9001 since 1993

Energy management

ISO 50001

RESPONSIBILITY

Black passion

The versatility provided by graphite's crystalline structure is what makes it so successful. And we use the "black diamond" as the inspiration for our company's success in this regard. We pay particular attention to occupational safety, quality assurance and sustainability. We take social responsibility seriously. We also like to play our part in the community. Intelligence in Graphite.



Social commitment

Promoting cultural events, educational initiatives and sports is an important focus for our company. Regionally, we support the "Stiftung Kropfmühl" and, through the charitable organ-isation "Förderverein Graphit Kropfmühl Besucherbergwerk e.V." founded in 2010, we are committed to the preservation of the only graphite visitor mine in Germany. History and tradition are strongly rooted within our company and the surrounding region. As a result, even today, the tradition of the miners' association with its band and choir is still actively maintained and supported.



Social responsibility

For us, taking social responsibility means always monitoring societal concerns and considering these within the context of corporate decision-making. We view it as our task to protect the environment and the climate through energy-efficient business. The graphite we produce is tested and evaluated for its potential impact on the environment. Generally speaking, graphite is not a hazardous substance. No environmental impacts can be expected from using, processing or disposing of it. We are guided by ethical principles for the fair treatment of our customers, business partners, employees and colleagues. We also attach great importance to compliance with moral and legal standards.



Want to feel what it's like to be a real miner? Then head underground with us and experience our unique graphite mine in Kropfmühl up close yourself! No matter the weather, our visitor mine offers an unforgettable experience for the whole family, thanks in no small part to the Graphiteum museum, opened in spring 2016! For more information, simply scan the QR code on the right with your phone's camera.



Discover the world of mining up close in Germany's only graphite mine in Kropfmühl!





















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