COMPLETE GEOCHEMICAL ASSAY SERVICES
GLOBAL LABORATORY NETWORK
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MSALABS

Technical Document - Carbon

6
C
Carbon
12.011

Graphite is a native element, meaning it occurs naturally in pure elemental form and along with diamond is a polymorph of carbon (C).

Graphite is one of the strongest and most stable substances on earth and maintains these properties to temperatures in excess of 3600 degrees celsius.

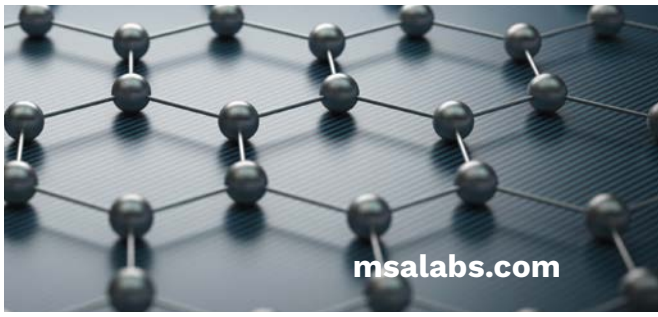
It has been traditionally used in the steel making industry to line crucibles and ladles and as a component of the refractory bricks that line furnaces. Harder and stronger high-carbon steel is also produced by the controlled addition of graphite that allows the characteristics of the final product to be tailored to its end use.

It is important to be aware that nomenclature for graphite speciation tests are not well standardised and lab report variations may occur

PROPERTIES AND USES

Graphite is the lightest of all reinforcing agents and when processed and bonded within a plastic resin can produce structural materials that are significantly stronger and lighter than steel. Commonly referred to as "'carbon-fibre" these composite materials are now found in everything from bicycles to commercial passenger aircraft.

In recent years, the largest increase in demand has come from the battery industry where the anodes in Lithium (Li) ion batteries accounted for 25% of global graphite production in 2016. Expanded graphite, which has been chemically and physically treated to produce large thin sheets and foils, is another high-tech application finding new uses in thermal management of consumer electronics as well as specialised conductors and gaskets.



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TYPES OF OCCURRENCE AND RECOMMENDED ANALYTICAL METHODS

Economically recoverable graphite can be broken down into 3 main categories as follows:

Flake Graphite

Flake Graphite occurs as large isolated plate like crystals that form through the metamorphic reduction of sedimentary organic carbon. Typical host lithologies include limestone / marble, schist and gneiss. From an economic standpoint, the larger the crystals the higher the price, which ranged from $700 a ton for small flake (-100 mesh) to over $1700 a ton for large flake (+50 mesh) in 2016. This is the most desired form of graphite since it has the highest purity and is most easily processed into high value products.

Amorphous Graphite

Amorphous Graphite occurs as small crystalline particles and is most commonly associated with partially or completely metamorphosed coal beds. This is a less desirable and lower cost form of graphite due to its generally lower purity and increased costs to process into useable forms for high-tech applications. It is used for furnace linings, brake and clutch parts and casting mold release applications.

Vein Graphite

Vein Graphite occurs as massive platy intergrowths of fibrous needles or crystals and is usually associated with the hydrothermal alteration of oil. Also of lower value, its physical properties make processing into a final product for high-tech applications economically unviable. Similar to amorphous graphite it is used for furnace linings, brake and clutch parts and casting mold release applications.

ANALYTICAL METHODS FOR THE DETERMINATION OF GRAPHITE AND CARBON SPECIATION

Carbon occurs in three main natural forms in geological materials. It is important to note that nomenclature for graphite speciation tests is not well standardised and what commercial laboratories report for each species can vary (for example some laboratories report total organic carbon as the sum of graphite and organic carbon, while others do not include graphite in the sum).

All carbon tests are determined using an induction or resistance furnace coupled to an infrared analyser. The sample in fully combusted and all carbon released is converted to CO2. The CO2 is then passed into an infra-red (IR) analyser where attenuation of the IR radiation is proportional to the amount of CO2 present.

Total Carbon is determined by total combustion of the sample in an induction furnace at approximately 1800 degrees Celsius with the aid of exothermic catalysts. Total carbon is measured in a single test and is the sum of organic, carbonate and graphitic carbon.

To determine Carbonate Carbon a split of the sample is placed in a sealed vessel with a strong mineral acid which breaks down carbonates but does not attack organic or graphitic carbon. Liberated CO2 is then passed through the IR cell to determine concentration.

Organic Carbon is determined by taking the difference between a total carbon analysis, and analysis of a second split that has been ashed at 550 degrees Celsius to remove only the organic fraction.

Graphitic Carbon is determined by ashing a split of sample pulp at 550 degrees Celsius to remove organic carbon, followed by leaching with hydrochloric acid to remove carbonate carbon. Graphite is them measured directly on the residue.

Package Code	Description
SPM-110	Total Carbon
SPM-120	Carbonate (Inorganic) Carbon
SPM-130	Organic Carbon
SPM-140	Graphite Carbon

If you have any questions, or would like to discuss an alternate analytical method to those described above, please contact MSALABS Customer Service.

DELIVERING A FULL RANGE OF GEOCHEMICAL LABORATORY SERVICES GLOBALLY

EXTENSIVE RANGE OF SERVICES

- PhotonAssay™ Analysis (Gold, Silver and Copper*)
- Sample preparation, storage and disposal
- Precious metals by Fire Assay
- Multi-element packages - Basic, Trace, Ultra-trace
- Fusion, ICP-OES and ICP-MS
- XRF
- Specialty Assay
- Biogeochemistry and Hydrogeochemistry
- Metallurgical Samples Analysis and Services
- Mineralogical Services

** Copper assay only available in select locations and is not currently available in Canada*

BROAD RANGE OF COMMODITIES

We operate across a broad range of commodities.

- Gold
- Silver
- Platinum Group Metals
- Copper
- Rare Earth Elements
- Cobalt
- Lithium
- Lead
- Zinc

STRINGENT QUALITY STANDARDS

Our company maintains the highest quality standards and follows the guidelines of ISO17025 accreditation and ISO9001, ISO14001 and ISO45001 certification. Certificates are available for download from our website.

Additionally, we participate in CDN Labs, Geostats, PTP-MAL, and Rockslabs Proficiency Testing Schemes (PTS), among others.

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EXPERTISE IN SITE-BASED LABORATORY MANAGEMENT

We have extensive laboratory design, construction and management experience in a range of countries.

We implement a complete set of systems, training, software and procedures enabling ISO certification and complete regular audits.

Our laboratories are managed by experienced, highly qualified staff, who undertake regular training.

MSALABS

EVERY SAMPLE **SAFELY** MEASURED
EVERY RESULT **RELIABLY** DELIVERED

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