

The bright side of graphite

Since the financial downturn at the end of 2008, the graphite industry has had to face additional challenges, particularly in 2009. Adverse weather, regulatory measures in China, and a continuing global recession has drastically impacted end markets.

Last year was without doubt tough and during the two first quarters of 2009, many producers worldwide had to close mines or reduce production (*IM March 2010: Graphite set to move up a gear*).

"After a long winter period some mines have just re-started in May and they are now processing the orders from April, so a lot of material ordered for April shipments has to be postponed to May and June," Dominik G. Luh, Technograft's managing director, underlined to **IM**.

The economic downturn heavily impacted small and new prospective future producers. "You could not start talking to an investor about a new project," Matimba Khoza, president of Jonkel Group, a South African explorer expected to start graphite production by the end of 2010 (*see below*), commented to **IM**. "It could be very risky for small companies to start operations as big companies had stocks in their reserves – meaning they could sell without spending money to produce, with allowance to sell in big discounts – while the demand was low," he added.

However, the industry is on the way to recovery as end user markets started to lick their wounds.

Andy Rill, vice president, materials management, at USA-based Superior Graphite, explained to **IM**: "Even after last year, destocking prices and capacity have held up well. With China being the largest producer of natural graphite in the world, the regional economic recovery/expansion has made impacts on the entire supply chain. Whether these impacts are positive or negative depends on where you are in the chain".

"The economic situation of the graphite users has strengthened all over the world," described Dominik G. Luh, Technograft's managing director.

One source of concern remains raw material

After a difficult 2009, graphite is starting to recover thanks to promising new applications, with opportunities in Africa, Canada and Australia for raw material

Alexandra Feytis, Assistant Editor

supply as China is the world's leading graphite producer and consumer. As Christoph Frey, technical director at Graphit Kropfmühl (GK) AG, underlined, with China dominating the graphite market, the influential developments in the graphite industry happen there. "The government closed or restricted some graphite mining areas. Together with high demand and further constraints due to bad weather and ownership changes, the supply from Chinese sources is currently rather tight with increasing prices," he said.

For producers in and outside China it is hard to meet demand. Chinese deposits, particularly, have to cope with purer graphite ore, and strict environmental controls. "The production capacity is still not on the level of previous years. In addition, we have increased the demand for graphite for Li-ion batteries, which affects the general availability of medium carbon materials for export," Frey added.

Supply is at present tight, but sufficient. Many companies are now looking for new sources of minerals outside of China in order to meet the expected growing demand from the electric cars industry for lithium-ion (Li-ion) batteries and opportunities are seen in regions like Australia, Canada but also Africa which hosts important deposits.

China leading the way

China is the largest consumer and producer of graphite, with 800,000 tonnes produced in 2009, which accounts for more than 70% of the world. The country also hosts more than half of the world top 12 producing companies.

Among them, Qingdao Everest Carbon Co. Ltd. specialises in processing and selling various carbon products of Everest natural crystalline flake graphite from sources in Heilongjiang, Shandong, Inner Mongolia, and Shanxi provinces. The company exports about

95% and 20,000 tpa of its material to 25 countries and regions. Besides Qingdao, where its head office is located, Everest also has branch offices, processing plants and warehouse in Xingang Port of Tianjin, Dalian, Yingkou and Bayuquan Ports to transport ship its graphite.

During last winter, Chinese production has been affected by severe weather conditions (*see IM March 2010, p. 29: Graphite set to move up a gear*).

"The production is still not working on full scale. Furthermore, the Chinese domestic demand is currently on a high level. So the Chinese supply for export is currently quite limited. Also the mines in Inner Mongolia still have not re-opened yet and it is uncertain that they will open this year. Their production quantities have to be substituted from other Northern Chinese proveniences," Technograft commented to **IM**.

India: Agrawal targets 2013

India is the world's second largest graphite producer after China with a production of 140,000 tonnes in 2009 which represents about 12.4% of the world output.

Among the main Indian players, Agrawal Graphite Industries is India's second leading graphite producer. The company has revealed to **IM** that it plans to double production by 2013 and to expand its portfolio into the battery market two years later.

"We feel that Chinese supply will go down because of the Chinese government laws", said Prabhas Agrawal, managing partner of the company, adding that "there is a huge potential in India".

Agrawal, which produces about 500 tpm graphite, will start with a 10-15% increase of production by November 2010 and plans to acquire two or three more graphite deposits near its existing operations in the state of Orissa, eastern India.

“The plan is to double our production by 2013 and for that to happen we need raw materials,” explained Agrawal.

In addition, the company intends to enter the sector for lithium ion (Li-ion) graphite for batteries and is in the process of a joint-venture with a Japanese company.

“Ideally, we target a production of 200 tpa by 2014 or 2015,” Agrawal told **IM**.

The company owns five mines – Temrimal, Dudkamal, Beharamunda, Deharmunda and Gandabhali – which are located in a radius of 60km from the main plant located near the village of Checherbeng in Belpara district, Orissa state, in the west of the country. The plant has a capacity of 10,000 tpa of processed graphite.

Agrawal also owns a second subsidiary plant near the village of Menkamunda in Bolangir district with a capacity of 1,000 tpa in addition to a semi-processed plant located at Temrimal mine and a semi-processed plant located near the village Mundapala near the Gandabhali mine.

One of the main concerns in India is the environmental issue which is taken very seriously by the Indian government and can sometimes slow down mining projects.

Competition from China for graphite is also a concern. “Raw material produced from the earth resource has limitation of supplies and hence the world competition and its impact in the world should be discouraged,” Agrawal explained.

Brazil looks to batteries

Brazil ranks second in natural graphite reserves (34.8% of the world total), and is the world’s third largest producer (6.8%), after China (70.8%), and India (12.4%), with a production of 77,000 tonnes in 2009. Economically exploitable reserves of graphite are mainly located in Minas Gerais, Ceará and Bahia, with 152.6m. tonnes combined reserves.

The best occurrence is in Pedra Azul, Minas Gerais, and is exploited by Nacionale de Grafite, one of the world’s leading natural graphite producers, which has over 250m. tonnes of measured ore reserves, possibly one of the largest independent reserve in the world.

Nacionale de Grafite, which has an annual production of about 52,000 tonnes from its three operations in Minas Gerais, has revealed to **IM** that it is ready to launch a new grade of spherical grade for the battery market, aimed at the lithium-ion design.

The company is expanding its portfolio into the battery market following the growing interest in the automobile industry as it considers electrification of the vehicle.

Nacionale de Grafite supplies graphite products for a number of markets including

refractories and brake linings and pads. These markets, owing to their intrinsic link to steel and traditional automobile sectors have suffered considerably since the global economic downturn began in September 2008.

European resources drop

Europe produces about 13,000 tpa graphite, the main producers being Norway, Ukraine and Czech Republic. However, the region has seen a drop in production during the last decade with a few European countries stopping production between 2001 and 2008, mainly owing to exhaustion from operations.

Sweden quit in 2001, followed by Austria in 2003. Germany, which used to produce about 3,000 tonnes back in 2001 stopped production in 2005 at the same time as Romania.

Africa’s potential

Africa is pointed out by many in the graphite industry as the place where to look for if the sector ever needs new sources of raw material in the next decade – which has some credence owing to the increase demand for lithium-ion batteries (*see p.12*).

Already a significant producer of graphite with 8,000 tonnes produced last year in Madagascar and Zimbabwe (*see below*), the continent is host to important as yet undeveloped graphite deposits notably in South Africa, Uganda, Angola, Tanzania, Ethiopia and Namibia.

The advantage of those graphites lie in their high flake content and the fact they are suitable for further high purification.

Luh from Technograft believes that southern African countries “could become an interesting source in the future.” Klaus Rathberger, managing director at Georg H. Luh GmbH, confirmed to **IM** that some deposits which were given up during the 1980s or 1990s owing to economic reasons were now getting into the focus again.

For Christoph Frey, if prices ever reach a level at which mining of new projects outside China is economically viable, Africa could be one source for graphite.

“Several graphite mines had to close due to the low graphite price level. If the prices increase, these mines could go back to production... Besides a suitable deposit, costs such as for labour and infrastructure are very much decisive,” he added.

Therefore, it is quite likely that as soon as market prices stabilise on a higher level, mining will become economically feasible. However, issues such as political instability and infrastructural problems are still a source of concern and discouraging factors for mining companies.

As Rill from Superior Graphite explained to **IM**, African graphite deposits are interesting

“from a quality perspective but geopolitical and logistical issues will be hindrances”.

Considering that it would take at least up to two years to set up new regular production in Africa, any investment would therefore be a high economic risk, especially if the economy then enters into stagnation, and much depends graphite applications.

“The challenge here in Africa is political stability as there is no reasonable company that can invest into a country with political and economical future uncertainty,” confirmed Khoza from South Africa’s Jonkel Group, who plans to start graphite production in the country by the end of 2010 (*see below*).

Underlining the case of Zimbabwe, Africa’s other graphite producer with Madagascar, Khoza believes that among all the African countries, South Africa remains the most attractive for foreign investors. “Zimbabwe had good graphite through its Lynx graphite mine. The mine had to close last November because of the conditions imposed by the government,” Khoza commented, concluding that “so far, South Africa appears to have a sound political and economic policy”.

South Africa to enter graphite

The advantage South Africa has compared to the rest of the continent is that there is good infrastructure to exploit raw materials, such as well established rail, road and sea transportation.

As a consequence, South Africa’s Jonkel Group intends to produce graphite before the end of 2010, through its subsidiary Jonkelkokoza Minerals and Resources (Pty) Ltd (Jonkel Mine) created a year ago in order to “exploit existing and future natural graphite opportunities”.

“Jonkel Mines has identified all economic graphite deposits here in South Africa and is working on them for future mining,” Matimba Khoza, president of the group, revealed to **IM**, adding that he was planning to start “on a small scale” with about 100 tpa of purified graphite.

Jonkel owns three graphite deposits in the Limpopo province, including the Steamboat deposit which has a grade of 8.8% of 2mm disseminated flake graphite and estimated resources of 3.5m. tonnes according to the company’s last feasibility study.

The three major economic deposits happened to be on community land, so Jonkel is on a joint-venture agreement with the local community to exploit them. But “the process of acquiring them started in 2009 and is not yet finalised with the administration of Department of Minerals,” explained Khoza.

The plan for Jonkel Mines is to supply its sister company, Jonkel Carbons and Grafites (Pty) Ltd – also created in Q1 2009, which would then process and manufacture Jonkel

Graphite at a glance

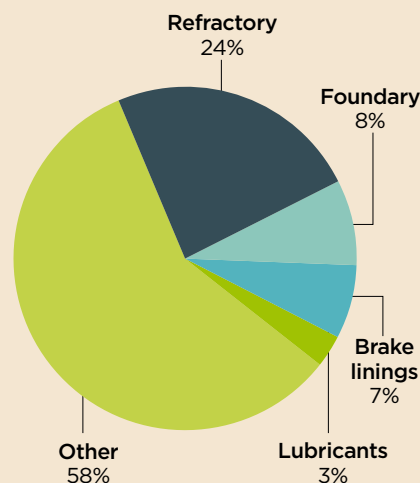
- Formula: C (carbon)
- One of four forms of crystalline carbon; the others being carbon nanotubes, diamonds, and fullerenes
- Occurs naturally in metamorphic rocks
- Three types of natural graphite: amorphous, flake and vein/lump (see table below)
- Has a melting point of 3,927° C and is therefore highly refractory
- Natural graphite is mined from open pit and underground mine operations
- Mines in Madagascar are mostly open pit. In Mexico, the Republic of Korea, and Sri Lanka, where the deposits are deep, underground mining techniques are required.
- World production (2009): 1.13m. tonnes
- Main producers: China, India, Brazil, North Korea, Canada, Norway (see table p. X) Account for 96.3% of world production

Properties

Graphite has properties of both metals and nonmetals, which makes it suitable for many industrial applications such as in batteries, fuel cells, and refractories.

- Excellent electrical and thermal conductivity
- Outstanding lubricity
- High thermal shock resistance
- High temperature resistant up to >3000 °C in O₂-free atmosphere
- Resistant to acids and oxidising agents
- Formation of intercalated compounds
- Inertness

Natural graphite applications in the USA 2009*



* Apparent consumption 13,000 tonnes

Source: US Geological Survey, 2010

World reserves of graphite

Country	Crystalline > 1 microns m. tonnes	Country	Microcrystalline < 1 microns m. tonnes
China	400	India	180
Ukraine	100	China	100
Madagascar	100	Mexico	100
Sri Lanka	80	Sri Lanka	100
Brazil	15	Austria	100
		South Korea	100

Types of graphite

Type	Quality	Occurrence	Applications	Prices	Deposits
Amorphous	70-85% C Most abundant	Refers to its very small crystal size and not to a lack of crystal structure	Used for lower value graphite products Brake linings, refractories, steelmaking	Lowest priced graphite	Large amorphous graphite deposits in China, Europe, Mexico, and the USA
Flake / crystalline flake	85-90% C Less common	Occurs as separate flakes that crystallised in metamorphic rock	Can be processed into expandable graphite for many uses, such as flame retardants Batteries, brake linings, lubricants, refractories	Can be four times the price of amorphous	Austria, Brazil, Canada, China, Germany, and Madagascar
Vein / lump	90-96% Rarest	Occurs in veins along intrusive contacts in solid lumps	Steelmaking	The most valuable	Only commercially mined in Sri Lanka
Synthetic graphite	97-99.9%		Used as carbon raiser additive in iron and steel in manufacture of catalyst supports; low-current, long-life batteries, porosity-enhancing inert fillers, powder metallurgy, rubber, solid carbon shapes, static and dynamic seals, steel, valve and stem packing		

Mines's graphite for domestic consumption.

Only one of Jonkel Carbons' two premises located in the Diggers Rest and Nine Pence provinces is operational, Nine Pence needing renovations. The plant buys raw materials from other graphite producers such as Germany's SGL Carbons and China's Qingdao Hensen Graphite Co. Ltd.

There have been no graphite producers operating in South Africa since the exit of Germany's GK Graphite exited the business some years ago: This new operation will instate Jonkel as South Africa's sole graphite producer.

The country could show good growth opportunities as there is a need for graphite, the black raw material being mainly imported from China. In 2008, domestic consumption was estimated to be over 3,000 tonnes.

Madagascar supply

Madagascar is the main graphite producer in Africa with a production of 5,000 tonnes in 2009. The African island used to be an important graphite producer a decade ago with a production of 12,580 tonnes in 2001 according to Roskill data. But the output decreased by about 2.5 owing to energy and production costs issues.

"Madagascar is very poor in fossil fuels, which are needed for the graphite production, especially for drying. With increasing oil prices the production cost are also increasing," Luh from Technograft explained to **IM**.

"Furthermore the deposits are getting poorer and poorer and further processing is needed to achieve an acceptable quality. On the other hand, most of the graphite producers do have other products like sisal, mica, cacao, etc. With these businesses, they have less risk and production cost," he added.

From the former four suppliers in Madagascar, there are only two left, Etablissements Gallois now being the only one with regular production and regular exports.

The Malagasy family-owned company has a capacity of about 10,000 tpa at its three mines - Antsirakambo Marovintsy and Ambalafo-taka - located on the east coast of Madagascar, in the Toamasina and Vatomaniry regions. The mixing plant and transit department are based in the city of Toamasina, Madagascar's main port.

Zimbabwe

Apart from Madagascar, Zimbabwe is the only other African graphite producer at present thanks to Zimbabwe German Graphite Mines


(ZGGM) Pvt. Ltd, a 50%-owned subsidiary of German graphite producer Graphit Kropfmühl AG, the remaining 50% being held by shareholders since 1967. Zimbabwe also had to reduce its production from 11,837 tonnes in 2001 to 6,600 tonnes in 2008 and 3,000 tonnes in 2009.

The Zimbabwean mine, called Lynx mine, had to reduce production last year in November because of the economic downturn. "Production last year was affected by the global crisis so the output of concentrate was below 3,000m. tonnes. This year we expect production well above 5,000m. tonnes," Christoph Frey, technical director at Graphit Kropfmühl AG, revealed to **IM**.

GK eyes Mozambique

Mozambique has large natural flake graphite reserves estimated to be about 1m. tonnes of ore with a content of about 10% graphite.

Kenmare Resources Plc, better known for its Moma mineral sands operation also in Mozambique, owned 80% of Ancuabe mine in the province of Cano Delgado in Northern Mozambique, the remaining 20% being owned by the government. Kenmare operated the deposit between 1994 and 1999 but the company had to stop production in 1999



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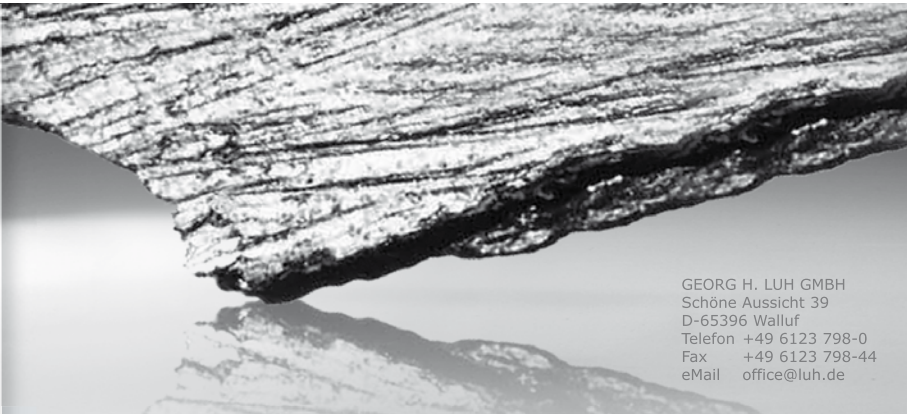
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**Market Projections and
Company Strategies to 2013**

owing to high energy costs and to the fact that the average price of graphite fell from around \$1,300/tonne to \$450/tonne (*IM 22 July 2008: Rising interest in Mozambique graphite*).

In 2007, the Mozambique government announced its intention to re-open the mine. The fact that Ancuabe is now connected to the hydroelectric power produced from the country's Cahora Bassa Dam, rather than having to generate its own electricity, will certainly provide added incentive to the project's restart.

As reported by **IM** in January 2009, Timcal Graphite & Carbon, part of Imerys SA, wined the tender and agreed a deal with the Mozambican government to restart graphite operations at Ancuabe. But the deal was dropped in March 2010 as the French mining giant then estimated that the reserves in the mine was too small.

However, the deposit is still the centre of attention from Europe as a source from the Ministry of Mines revealed to **IM** that Mozambique is now negotiating with German graphite producer Graphit Kropfmühl (GK) AG. GK confirmed to **IM** that it is currently performing some investigation and re-evaluation on the Ancuabe mine. Supply from China being "no longer as smooth as it was for many years", the German company decided to start investigation for new sources of material in order to secure on the long term additional own resources to extend the mining and production assets GK already holds.

As Frey explained, the project is still at an early phase so it is too early to decide on a fixed schedule for restarting the mine or an exact production level. "Further steps depend on the results we get and the decision on how to proceed will be taken probably beginning of next year," Frey said, adding that negotiation on an acquisition would only start thereafter.

"But we believe Ancuabe could be brought back on stream within one or three years and production level could be several 1,000 tpa," he added. A decade ago, Ancuabe had a production of 7,500 tpa natural flake graphite, but the mine is said to have a capacity of about 10,000 tpa.

Despite being "always open for the evaluation of graphite projects", GK specified that its main focus is at present the Ancuabe project for its raw materials activities.

New project in Canada

Canada produces about 2.4% of the world graphite production with 27,000 tonnes in 2009. It is the fifth biggest producer after China, India, Brazil and North Korea and before Norway and Mexico.

Timcal Ltd, one of the world's leading producers of graphite products and the Switzerland based subsidiary of Imerys, idled production in Canada at its natural graphite mine in Lac-des-Iles, Quebec, during Q1/Q2 2009. But when the market started to show cautious signs of recovery, "production started again at the beginning of June 2009, reaching full production during summer 2009," Fabrizio Corti, Timcal's vice president sales and marketing, told **IM**.

The country is still subject to new projects as Northern Graphite Corp., a subsidiary of Industrial Minerals Inc., has hired SGS Canada Inc. to carry out a pre-feasibility study at its Bissett Creek graphite project in Ontario, Canada. The study is expected to be completed in Q3 2010 after further metallurgical testing and an infill drilling programme. "We intend to be in a position to make a construction decision by the end of 2011," Northern Graphite's chief executive officer, Gregory Bowes told **IM**.

The drill programme is to confirm previous results, upgrade some inferred resources to the measured and indicated category, and evaluate

Main graphite producing countries (tpa)

Country	Production estimates (2009)
China	800,000
India	140,000
Brazil	77,000
North Korea	30,000
Canada	27,000
Norway	15,000
Mexico	10,000
Ukraine	8,000
Sri Lanka	7,000
Madagascar	5,000
Czech Republic	3,000
Others	8,000
Total world	1.13m.

Source: US Geological Survey

the potential to increase production two to four times should demand warrant in the future.

"Only a small percentage of the property has been drilled to date and there is good evidence to suggest that this is the case," he underlined.

The project was subject to a full feasibility study by Kilborn Engineering and others in 1989, but was not developed due to the subsequent decline in graphite prices. However stronger prices, driven by demand from emerging economies, have rekindled interest in the property.

"A substantial body of high quality work has already been completed and we do not expect any surprises but it is important and necessary to bring it up to NI 43-101 standards," Bowes said.

"Environmental and permitting work is already underway and our goal remains to be in a position to make a construction decision within 12 to 18 months," he added.

Northern Graphite raised C\$1.47m. (\$1.45m.) to develop Bissett Creek in March 2010 through a private placement (*IM 11 March 2010: Bissett Creek graphite boost*).

Australia to go on stream

Australia plans to produce graphite at the Uley graphite project, located about 23km from Port Lincoln on the Eyre Peninsula in South Australia. The deposit, owned by Strategic Energy Resources Ltd (SER), has total resource of 3.2m. tonnes at 9% C (*IM April 2010, p. 46: Australia: Land of Plenty*).

According to the company, "Uley is recognised as an area of world class graphite mineralisation" and SER's deposit, part of the Mikkira graphite province, could be one of the largest coarse flake graphite deposits in the world, containing disseminated, high-grade flake graphite.

World top 12 producers

Company	Location	Capacity (tpa)
1 Jixi Liumao Graphite Resource Co. Ltd	Heilongjiang, China	80,000-90,000
2 Heilongjiang Aoyu Graphite Group Corp.	Heilongjiang, China	80,000
3 Chenzhou Luteng Crystalline Graphite	Hunan, China	70,000
4 Nacional de Grafite	Brazil	70,000
5 Karabek Metal and Mining	Turkey	50,000
6 Zavalyevsky Graphite Complex	Gayvorigon, Ukraine	40,000 - 60,000
7 Qingdao Hensen	China	38,000
8 Extractive Metaquina	Brazil	30,000 - 40,000
9 Lubei Yxiang Graphite	China	30,000
10 Jilin Graphite Industry	China	30,000
11 Qingdao Heilong	China	30,000
12 Luobei Yiyang	China	30,000

Source: Roskill Information Services Ltd 2009

Exploration during the 1980s led to the re-opening of the mine in 1986, but a sharp decline in world graphite prices in 1992 and an increase in freight prices caused the mine to cease production in 1993.

When in operation the plant had a capacity of 14,000 tpa and the aim was to progressively build-up to 20,000 tpa rating the Uley project as one of the largest in the world.

"The existing plant and metallurgical test work provide a strong platform to undertake a robust feasibility study for a 10,000-20,000 tpa operation," said SER which is looking for investment and/or a joint venture partnership.

Promising applications

Without graphite no industry would be able to operate since most require graphite, albeit in small volumes. As shown on p35, graphite can be used in many different applications such as refractories – the main consumer with about 30% share of the market – flame retardants, lubricants, and foundries. Foundry also seems to be a promising market. "The market for graphite used in foundries is steadily increasing," Thomas Junker, director sales and marketing at Graphit Kropfmühl AG, told IM (*see p. 40 for report on foundry market*).

One of the most promising end markets for graphite is the lithium-ion batteries sector, which is expected to drive the industry to a shortage in raw material by 2020 (*see p. 12*). Energy storage systems like alkaline manganese batteries show very significant growth too.

However, a few other uses are seen as promising such as the construction industry where graphite can play a vital role in the future as functional filler, eg. infrared shielding or heat conductivity.

"Energy-related uses will also play a major driving force concerning the worldwide graphite market, at least during the next decade," Klaus Rathberger, managing director at Georg H. Luh GmbH told IM, adding that advanced battery and energy storage technologies which are using graphite (eg. fuel cells) might come into mass market during the next five years. "Graphite for fuel cells is bearing a good potential for the future," Frey confirmed.

In addition, the usage of expandable graphite as a flame retardant as well as the usage of micronised graphite in heat sinks for electronic components are promising.

Andrew Rill, Superior Graphite, believes that although environmentally challenged, acid treated graphite for foil and insulation

will continue to be a high value product. "High purity grades for energy material applications are certainly becoming a bigger demand draw each year and will continue going forward," he said.

In South Africa, Matimba Khoza from Jonkel bets on renewable and clean energy. "Although nuclear power has its own critics, analysts believes it is the future regardless of the negative radioactive impact. Graphite is the main component in building a nuclear power station," he commented to IM, pointing out that the country is at present working on such a project with a government tender won by SGL Carbon.

The electric car is another promising prospect not only because of Li-ion batteries but because parts of vehicles may be manufactured by graphite fibres instead of steel in order to reduce the weight of vehicle.

Supply: towards a shortage?

About 92.4% of natural graphite in the world is produced by Asia and Brazil. Global production has increased during the last five years by about 2.5% to meet demand from a growing range of applications. It is more than likely that demand will continue to dramatically augment during the next ten years, thanks to the Li-ion batteries boom.



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Therefore, the question of graphite supply in the future has become a source of concern for the industry. Firstly, because it is not sure if the current producers will be able to meet the expected future demand. In a report released on 17 June, the European Commission revealed that graphite was among its 14 “critical mineral raw materials” considered a supply risk for EU economies (*IM 17 June 2010: EU names 14 critical minerals*).

Secondly, the “China factor” has to be taken into consideration. The rapid growth in demand for raw material in China, the world main graphite producer and consumer, has led to a significant change in supply. Even though China is still an important exporter (74% in 2008), it is expected that exports from the country will drop over the next decade.

As commented Rathberger, if a shortage is visible in the market, it will be more a question of, for example, strategic decisions of Chinese authorities, and investment decisions in refining plants, rather than of mining capacities.

“The challenge is to foresee the tendencies on the Chinese market for both supply and demand as each are the most relevant on global scale. If things change in China, like additional restrictions for mining or quantity quotas for sales are installed, the market could change quite quickly and significantly. But it remains difficult to predict if the Chinese government is willing to influence the graphite market and if so in which way. The consequences could result in additional economic viable mining activities outside China besides the already existing ones,” Frey explained to **IM**.

The Chinese government has recently increased tax on graphite exports in order to discourage exports as the country needs raw material. As a consequence, countries such as the USA must look for new sources to meet their Li-ion manufacturing needs. “Unless new sources are developed, there will be definitely not enough graphite within the next few years,” believes Khoza, adding that it could be the reason why big producers turn to sources like south America and Africa.”

Therefore, deposits outside China, such as in Africa, are becoming a centre of interest and could be one of the answers in the long term, as explained above if prices increase (*see Africa’s potential*).

However, as a newcomer to the graphite market, Jonkel underlined to **IM**, “the challenge of supply is that it is not easy to enter the supply market. You cannot enter it overnight. Consumers look at several factors before they approve new source. A source must have potential of quality material and a possible supply on a reasonable period of time without unnecessary stoppages,” he said.

Corti from Timcal remains more optimistic,

IM graphite prices 2010

Type	Price range (February)	Price range (June)
Graphite, crystalline large flake, 94-97% C, +80 mesh CIF UK/main European port	\$1,250 -1,500/tonne	\$1,300 -17,000/tonne
Graphite, CIF European port, FCL Crystalline fine, 90%C, -100 mesh	\$550 - 700/tonne	\$650-850/tonne
Graphite, CIF European port, FCL, Crystalline fine, 94-97%C, -100 mesh	\$700 -1,050/tonne	\$750-1,200/tonne
Graphite, CIF European port, FCL, Crystalline fine, 94-97%C, -100 mesh	\$1,100-1,350/tonne	\$1,100 - 1,450/tonne

* Prices examples quoted in market place at time of press on 15 June.

See p.70-71 for range selection and www.indmin.com/prices for full listing

warning that it is “fundamental to reduce any wasting. If the market is ready to pay the right price, there will be no shortage of natural graphite... Natural graphite is an important and precious resource,” he commented to **IM**.

“Present graphite prices are still too low to justify new graphite projects or new graphite mines. But in three or five years the situation could be more favourable,” he added.

Boost in prices

As reported by **IM**, after a drop over the last few years, graphite prices have been increasing in recent months. As Klaus Rathberger explained, the price increase was driven by recovering demand worldwide and, to a certain extent, also by a concentration of producer base, at least in China.

As most material is bought in US dollars, the US\$/euro rate, which has fluctuated recently, has a major influence on the material cost for European buyers.

“I expect that after the significant increase in graphite prices of the last few months the situation would stabilise around the current level,” Rathberger said.

Andrew Rill also expects some stability in the short term and further escalation related to tightening of supply as the result of growth in developing application and increases in personal consumption in the mid-term. On the long term, Rill foresees “prices stability and possibly periods of price reversal as new capacity comes on line.”

Luh from Technograft believes that prices could rise again, mainly because the increased demand for raw material prevents graphite plants to build up any stocks, “which could put a pressure on the price again. If the situation continues, we would estimate that price increases will follow,” Luh analysed, warning that “only a slow-down in steel economy can stop the increase and lead to the stabilisation of the prices.”

Khoza from Jonkel is more categorical. “The ABC way of business analysis is based on supply and demand. I do not imagine the situation in which demand exceeds supply and the prices decrease. Come 2020 and the producers cannot meet their consumers’ needs, I foresee rather a double in prices,” he forecasted to **IM**.

Outlook: a bright future

After keeping a low profile during the global downturn, it seems the graphite industry can now count on a brighter future on the medium to long term, thanks to a steel industry on the way to recovery, and to continued growth in leading edge applications and mineral resource development such as Li-ion batteries for electric cars. “The graphite industry as a whole can have an optimistic view to the future,” Klaus Rathberger believes.

Frey confirms that “global demand will further increase” even though the key supply role played by China makes the future of the graphite market a little bit uncertain. “But on the other hand, the global graphite industry is well developed and will find suitable answers,” he said, adding that “a shift to more sources outside China can be expected within the next decade.”

Even though a graphite shortage may be feared in the future, worldwide deposits outside China could possibly meet anticipated increased demand, and it is likely more graphite mines will be opened or re-exploited within the next decade.

Graphite is a very special mineral with unique characteristics required in many existing and future technologies. Agrawal, of Agrawal Graphite Industries, India, considers that the black material “should be conservatively used, fully exploited without any wastage of a gramme of mineral so that future availability is not disturbed,” and concludes: “No Graphite, no industry.”