SiC & MORE

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LIAONING & THE MAGNESIUM CAPITAL OF CHINA



SiC & More recently had the opportunity for an interview with the management team at Liaoning New Development Enterprise Group Co. Ltd (Liaoning). The sit-down proved to be extremely interesting and informative and represents ***SiC & More's*** first in-depth article about a magnesium producer.

Liaoning New Development Enterprise Group Co., Ltd. was founded in 1993 and is located in Dashiqiao City, Liaoning Province, known as the "Magnesium Capital of China". Liaoning is a highly professional organization that combines scientific research, production, and trade.

The company's main products are fused magnesia and high-purity magnesium oxide powder. Fused magnesia has high body density and high crystallinity (average crystal size of 2000) μ. These characteristics are two step crystallization products with world leading quality. The company independently researched and developed the country's first rotary electric furnace and other patent projects, and cooperated with Northeastern University to develop the industrial Internet management and control system. Through high-end intelligent and green applications, the company significantly increased output and reduced energy consumption. The company has a well-established testing center, using a German Bruker spectrometer, and the testing results are in line with international standards.

The company produces 50,000-60,000 metric tons of products annually and exports them extensively to North America, South America, Europe, and Asia, with an export volume of over 90%.

The company (formerly known as NEW TYPE Group) was listed as a national level new product by the Economic and Trade Commission in 2000. In 2006, it was awarded the "Top 10 Brands of the Year for Going Global", and in 2007, it was awarded the "Top 10 Economic Innovators in China". In 2012, Liaoning applied for the first national patent investment project within the central budget and received approval. The company's products are applied in industries such as chemical, aerospace, and military industries. With advanced production technology, excellent product quality, and high-quality after-sales service, the company has won the trust of its entire customer base.

The total assets of the company are 3 billion yuan, with over 200 employees. The group has four independent accounting subsidiaries: Liaoning New Development Refractories Group Co., Ltd., Liaoning Meiyu New Materials Co., Ltd., Yingkou Qingxin Mining Co., Ltd., and Yingkou Zhenhua Magnesium

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KYMERA INTERNATIONAL SIGNS DEFINITIVE AGREEMENT TO ACQUIRE FIVEN ASA, A LEADER IN ADVANCED SILICON CARBIDE MATERIALS



Kymera International to acquire Fiven ASA, adding advanced silicon carbide capabilities to their high-growth specialty materials portfolio.

With production facilities in Norway, Belgium and Brazil, as well as a global distribution network, Fiven is a pioneer in the development of technically advanced silicon carbide materials to a wide range of high-growth end markets. Through its recent R&D initiatives, Fiven has developed and marketed unique, high purity materials for the power electronics industries, such as semiconductors and lithium-ion batteries. Under the leadership of Fiven's CEO, Falk Ast, the company continues to drive innovation, deep collaborative relationships with its customers and a strong emphasis on ESG.

"Fiven has all of the strong attributes we look for in an acquisition. They have an excellent reputation for quality and service, are aligned with Kymera's strategy of focusing on attractive end markets such as electronics, aerospace and defense, and have an outstanding management team and dedicated workforce," comments Barton White, CEO of Kymera. "We are excited to partner with Falk and his team to continue growing Fiven and capitalize on the numerous operational and commercial synergies we have already identified."

Kymera has been owned by affiliates of Palladium Equity Partners, LLC (collectively, "Palladium"), a middle market private equity firm with over $3 billion in assets under management, since 2018.

"The acquisition of Fiven will accelerate Kymera's mission to become a high-growth specialty materials and chemicals platform, and unlocks substantial organic growth opportunities for the combined business," adds Adam Shebitz, Partner at Palladium Equity Partners. "Altogether, Kymera is well on its way towards achieving Palladium's investment objectives, having more than tripled in size from our initial investment, while creating a more resilient business oriented towards the industries of tomorrow."

The terms of the transaction were not disclosed.

Kymera's M&A efforts were advised by Lazard and Paul, Weiss, Rifkind, Wharton & Garrison LLP, and its debt financing was advised by Piper Sandler, Goldman Sachs and Paul, Weiss, Rifkind, Wharton & Garrison LLP.

OpenGate Capital was advised by Baird and Willkie Farr & Gallagher LLP.

About Kymera International
Kymera International, through acquisitions, can trace its roots back to the 1800's. Today, Kymera International is a U.S. owned, leading global developer and manufacturer of advanced specialty materials and high-performance surface coatings. Kymera sells its technically developed products into a wide variety of end markets, including aerospace, defense, medical, electronics, chemical, specialty auto, additive manufacturing, and numerous industrial applications. Kymera International has manufacturing facilities in the U.S., Canada, Australia, Europe, UK and Asia. For more information, please visit www.kymerainternational.com.

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> Liaoning– Cont from page 1

Research and Development Co., Ltd. Among them, Qingxin Mining Company has mines with reserves of 128 million tons, with an annual mining output of 1 million tons. The business includes a scientific research and processing line that includes mining, comprehensive utilization of magnesite, deep processing of refractory products, selection and processing, and integrated production of finished products. The group has passed the ISO9001 international quality management system certification, and the quality management system is operating effectively.

The company is located in a unique geographical location with convenient water, land, and air transportation. It is adjacent to the Harbin Dalian Expressway and railway, 45 kilometers away from Bayuquan Port, 210 kilometers away from Dalian Port, and 19 kilometers away from Yingkou Lanqi Airport. The company enjoys unique advantages in resources and transportation location.

The company adheres to the fundamental development of "technological innovation and striving for excellence", the corporate spirit of "high-quality, cost-effective, and never give up" attitude, and implements the work attitude of "speaking less, doing more, and striving for excellence". In addition, the company promotes comprehensive modern enterprise management systems and scientific research. These attributes enable the group to continue to grow and strengthen in what is a fierce market and makes Liaoning a pillar enterprise of the national and regional economy.

Liaoning welcomes friends from home and abroad to come and discuss business development opportunities and to tour their unique facilities.

> Kymera- Continued from page 2

About Palladium Equity Partners, LLC
Since its founding in 1997, Palladium has invested in more than 210 companies (40 platforms and more than 170 add-ons). With over $3 billion in AUM, the firm focuses primarily on buyout equity investments in the range of $50 million to $150 million. Palladium seeks to acquire and grow companies in partnership with founders and experienced management teams by providing capital and strategic guidance. The partners of the firm have meaningful experience in consumer, services, industrials, and healthcare businesses, with a focus on companies they believe will benefit from the growth in the U.S. Hispanic population. For more information, visit www.palladiumequity.com.

About Fiven ASA
Fiven is a global leader in silicon carbide (SiC), a material used a variety of industrial applications. SiC is recognized for superior hardness, high thermal conductivity and chemical inertness, making it the preferred material for demanding applications: abrasive, metallurgy, filtration, technical ceramics and other uses. Fiven has manufacturing sites in Norway, Brazil and Belgium. For more information, please visit www.fiven.com.

About OpenGate Capital
OpenGate Capital is a global private equity firm specializing in the acquisition and operation of businesses to create new value through operational improvements, innovation, and growth. Established in 2005, OpenGate Capital is headquartered in Los Angeles, California with a European office in Paris, France. OpenGate's professionals possess the critical skills needed to acquire, transition, operate, build, and scale successful businesses. To date, OpenGate Capital has executed more than 40 platform acquisitions across North America and Europe. To learn more about OpenGate, please visit www.opengatecapital.com.

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NHQ – VIETNAM'S ONLY SiC PRODUCER



Pictured above are large pieces of SiC located in the NHQ processing station. The oversize pieces, fresh from the furnace yard, will be broken into sizes suitable for feeding into the jaw crusher.

Since it had been about one year since ***SiC & More*** last visited with the management team from New He Qiao Shareholding Company (NHQ), Daniel Charles reached out to Vietnam's only SiC producer for an update.

During our last interview in April 2023, NHQ was operating at about 75% theoretical capacity utilization and had absorbed several kWh price hikes. Although the energy cost increases represented a substantial boost, they were, for the most part, on par with other regions of the world. As we prepare to enter the summer of 2024, NHQ management said, "No change compared to Q4, but since state power corporation is still running at a loss, we expect power rate would likely continue to move up in this summer." Depending on energy demand and the availability of off-peak power, ***SiC & More*** believes that NHQ's kWh pricing is in the $0.08-0.09 range. This ultimately means that energy costs alone, to produce one ton of SiC, could be in the range of $500-560 per net ton.

NHQ's volume remains steady in both South Korea and Japan, which are two key markets for SiC. Whereas business in EU softened by about 10% in Q1 2024 compared to the same time in 2023, sales to Indian SiC consumers jumped by 10% in Q1 2024.

Demand for NHQ's SiC remains strong due to dependable quality, decent pricing, strong delivery reputation, and a commitment from NHQ's management team to strive to improve on performance with each passing day.

In closing issue #97, ***SiC & More*** took a position that remains in play as we close out issue #102 in the spring of 2024, "Looking forward, assuming that energy is available at competitive levels, Vietnam is in the driver's seat when it comes to being one of the world's leading producers of SiC. Environmental, energy, and political issues in other countries make the landscape all that much more attractive for Vietnam and NHQ. This will be fun to watch unfold over the next 2-3 years."



Raymond mill at NHQ's processing station in Vietnam

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WHO SAID SiC PRICING WAS FLAT?



Silicon Carbide Stock Photo

In issue #101 of ***SiC & More***, we claimed that SiC pricing was as flat as the Maldives, which has bragging rights as the flattest country on the planet Earth. In fact, there is a miniscule elevation difference of 5 meters between the lowest and highest points and the country's terrain is consistently 1.5 meters above sea level.

When interviewing traders, producers, and processors for issue #102, one contributor to the newsletter claimed that SiC pricing was no longer as flat as the Maldives but was now only flush as Tuvalu, a reef country in the Pacific. Tuvalu is considered the second flattest country in the world with a mean elevation of about 2 meters, with slight variation. Truth be told, ***SiC & More's*** staff was simply pleased to hear that someone is actually reading the newsletter and appreciates the splash of humor.

Not much has changed over the past few months. China still dominates the world of SiC and their SiC furnace plants are operating at less than 50% of capacity. As a trader told ***SiC & More*** in issue #101, "You can bet your bottom dollar that the driving force behind the low efficiency is the sluggish Chinese economy. Not only that, demand out of EU and the states is also slow."

No doubt, the Chinese drive not only SiC supply but its demand. No doubt, one cannot believe the economic numbers coming out of China. For example, did China's gross domestic product beat forecasts by a wide margin by expanding by 5%? Boots on the ground in China claim that is not the case. As Stevenson-Yang said, "Start-ups are closing, no one can find a job, millions of people are paying mortgages on apartments that haven't been built, city services are closing down – it's a grim situation for Chinese people." In short, don't expect Chinese demand for steel, iron, aluminum, or SiC to increase during 2024. That generally means prices will soften unless supply is brought into balance to match demand, which is what has happened with SiC.

Price fluctuations for SiC tend to vary from abrasive to refractory to metallurgical grades. Like all SiC producers, profit is made on value added products dedicated to the abrasives, advanced ceramics, and refractory industries. Those prices have actually softened a bit ($20-$50 n/t) since the beginning of 2024 whereas metallurgical has seen a small erosion ($10-$20 n/t) followed by an increase of the same amount.

When asked what buyers should expect during the balance of 2024, a trader said, "China will attempt to export their way out of the economic predicament they find themselves. The problem for China is that countries like the U.S. have started to resist those efforts with tariffs or increased tariffs. I expect to see sideways pricing with efforts to implement increases. There could be some softening but I think that will depend more on other country's economies than on Chinese export efforts."

As a source told ***SiC & More*** in issue #101, "You got to love these pricing cycles. The sales price on about half of what a SiC producer pulls out of the furnace is losing money at current prices. This will last for a while then you will see production across the SiC landscape curtailed and inventories along the supply chain reduced to a minimum just in time for a surge in demand forcing prices upward."

Ultimately, when China drives the pricing on a commodity, forecasting prices is difficult at best. Most producers, traders, and processors are hoping that SiC pricing is as flat as Tuvalu.

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FRANCISCO BATISTA SOUNDS OFF

a) Energy: Although the last rainy season performed well below average, reservoirs were preserved due to the excess from other sources of energy (wind and solar). Long-term prices have dropped since last report from R$ 155/MWh to R$ 135/MWh ($26/MWh). The main reason continues to be the excess delivered from alternative sources and flat demand for energy in the near future.

b) Macroeconomics: Last interest rate cut by Brazilian Central Bank has frustrated the market as it was a 0.25% instead of the expected 0.5%. The justification was the more challenging scenario for the country's economy as a consequence of (i) the Brazilian President declaring he is no longer committed with zeroing the fiscal deficit during his administration (ending in 2026), and (ii) higher than expected inflation rate in the month of Apr/24. The immediate consequence of that was the FX rate jumping from R$ 4.95 to R$ 5.15.

FOCUS projections are now:

- Interest Rates: Dec/24: 9.75%; Dec/25: 9.00%
  FX Rate: Dec/24: R$ 5.00; Dec/25: 5.05

During the period between Apr 27 and May 14, the State of Rio Grande do Sul in Brazil has seen an accumulated rainfall close to 2,000mm highly concentrated in the center of the state where this rainfall is absorbed by only three rivers which all debouch at the flat region of Guaiba Lagoon where the capital city (Porto Alegre) is located. The Guaiba water level raised 5.5 meters in less than 48hours flooding 80% of the city. On top of that, over 70% of the municipalities of Rio Grande do Sul State were also heavily hit by the flooding affecting more than 2 million people. The death toll is already over 150 with more than 125 people missing. This is one of the very worst climate disasters in the history of Brazil. Local and federal governments are full force working on saving lives and relocating more than 400,000 people whose houses were completely destroyed by the flooding. In addition, 90% of the main roads in the state are blocked by mudslide and/or by collapsed bridges. Initial estimates for recovering the state are around R$ 120 billion ($24 billion) which will certainly affect 2024 GDP and increase even more the fiscal deficit for 2024 and 2025.

c) Commodities: the excess of production of everything in China is now causing damage in every market in Brazil despite the fact that a high FX Rate makes importing goods less competitive. We are seeing every hard commodity being offered by Chinese producers in Brazil for a price that in some cases are lower than those of pre-Covid. Local producers are feeling the pain and reacting against it by pushing the BR government to impose anti-dumping policy against Chinese competitors. Steelmakers are not only canceling their expansion plans but also cutting their current output. It is unclear how far the BR government is willing to go as lower commodity prices will help it meet the inflation target. In terms of soft commodities the recent climate disaster in Rio Grande do Sul will only fairly impact soy and corn crops as most of it had already been harvested when the flooding happened.

d) Politics: This is not the time to have a weak President in Brazil. On top of the disastrous international policy, the poor interaction with congress to push forward the necessary reforms and the already gigantic fiscal deficit, now this administration has to deal with the climate disaster in Rio Grande do Sul which will require not only crisis management capability (that this administration clearly lacks) but also a lot of money to recover the losses increasing the fiscal deficit even more. It is unclear if this administration will be able to cut expenses in other areas to offset the cost to rescue Rio Grande do Sul or if it will simply take more debt to cover it. Either way, the political impact is already being felt in the polls that show the majority of Brazilian disapproving of this administration.

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BFA, MgO & MORE



Bauxite Stock Photo

In issue #100 of ***SiC & More***, a processor said, "I have been through these roller coaster rides more times than I care to remember. When demand and pricing went to the moon in 2022, you had to know that what went up was going to come down. Well, here we are. Stagnant demand, too much inventory, hot competition, and over supply."

The situation for Al2O3 and MgO hasn't changed much since late 2023. In particular, prices on both DBM and fused MgO have been creeping up since early 2024 and that is due to a combination of factors including kWh pricing and the consolidation of the Chinese mining sector. Although prices have increased on both DBM and fused MgO in recent months, the prices are still well below what one would call historical levels.

With Al2O3, prices have also increased a bit and that is due to the price of bauxite. Bauxite is the key raw material ingredient to producing BFA. The ongoing issues with raw ore mining have continued to prop up the price of BFA and that is not expected to change any time soon.

Overall, it appears as if the industry is in a holding pattern waiting for a combination of events to play themselves out. For example, what is really happening with the Chinese economy and how do they inject some life into it? The result of new tariffs from U.S. and EU on many Chinese commodities. The ever-changing cost of energy. What is happening with demand across the globe and will it remain flat? Global conflicts that appear to be ongoing.

In this case, stagnant with a modicum of small increases and decreases can be managed. As a processor said, "Let's avoid the rocket ship to the moon like in 2022 and then the subsequent freefall in pricing."

TIDBITS FROM ZAPORIZHABRASIVE IN THE UKRAINE



Pictured above is an assortment of high quality SiC products produced at ZAK including powder (microgrits).

SiC & More has managed to provide ongoing updates regarding the efforts being made by Zaporizhabrasive (ZAK) to not only remain relevant, but to continue to grow and prosper despite the monumental obstacles of operating in a war zone.

Over the past few years, ***SiC & More*** has reported on ZAK's continuous progress during difficult times. For example, ZAK having access to emergency assistance of up to 500 MW thanks to ENTSO-E; improvements in logistics; upgrading the ZAK website with emphasis on an electronic catalog; investing in Genton equipment to improve feeding and mixing of charge materials; and most recently, increased production of SiC powders.

According to ZAK management, "Micropowders of silicon carbide widely used in different industries such as surface polishing and finishing for metals, wood, glass, stone, concrete brick, plastics, leather, different alloys, refractory, ceramic and abrasive industries, etc., the demand justified production increases."

The result was another step forward as the technical staff at ZAK developed a plan for grinding large fractions of black silicon carbide using crushers DR-32 (BONA). The introduction of this type of equipment resulted in a SiC powder productivity increase of 30%. ZAK currently dedicates the additional yield in SiC powders to its traditional markets in EU, Turkey, and domestically.

SiC & More will periodically reach out to our colleagues at ZAK and continue to report on their progress as they make it their mission to remain a viable business supplying value added products to its customers while fighting incredible adversity.

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ELECTRA PILOT TO DISRUPT IRON-MAKING

US start-up Electra has launched a pilot plant in Boulder, Colorado for its low-temperature electrochemical and hydrometallurgical processes to produce 99.9% iron plates as it seeks to help decarbonize the steel industry.

The iron plates will be an intermediary product produced from iron ore and be an input into electric arc steelmaking furnaces (EAF). Steelmaking generates an estimated 10% of the world's carbon dioxide emissions, of which some 90% stem from ironmaking.

"The steel industry is so important to the energy transition as it is in every field [from electric vehicles to wind turbines]. ... The conventional way to produce iron through blast furnaces has not changed for generations, there has not been a lot of disruption in this field," 20-year steelmaking veteran Francois Perras, chief commercial officer at Electra told ***SiC & More.*** Electra's pilot plant aims to demonstrate the viability of its low-temperature processes to produce iron plates. It can refine low-grade iron ores at 60°C, the temperature of coffee, rather than the 1300-1660°C of a typical blast furnace.

This potential disruption to the traditional steelmaking route is why US steel company Nucor is partnering with Electra, as are iron ore suppliers such as BHP, which supplied the iron ore for the pilot.

"The market sees an immense gap opening going forward as the conversion from blast furnaces to EAF's exposes the lack of metallic iron. We see a target market gap in the Western world of 50Mtpa by 2030. ... We offer the miners the opportunity to move from being an iron ore business to a metallics business," said Perras.

Electro's process dissolves iron ore in acid which drops out any silica contaminant. Changing the pH acidity level allows the extraction of phosphorus and alumina contaminants into discrete byproducts that can by commercialized. The ability to extract contaminants means that Electra can use a wide-range of iron ore sources, from commercial grade for iron-making, low grade iron ores and those with high impurity levels.

The resulting 99.9% iron plate, with dimensions of 1m2, means the gangue minerals are not transferred to the steelmaker, which will allow it to blend Electra's product with lower-grade scrap material in its melt. "When it goes to an EAF, it is a high-value product for the steelmaker as it permits them to use multiple types of scrap," said Perras.

"Electra's pure iron metal is uniquely positioned to allow the upcycling of a broader range of steel scrap into higher-value sustainable steel products, improving the circularity and sustainability of the steel industry," said Noah Hanners, Nucor's EVP of raw materials.

Pilot

Electra raised US$85 million in its series A funding round in 2022 and is currently working on a series B raise to complete the work programme to advance the project to the construction financing stage, at which point it will undertake a series C financing to fund the development of the first phase of a commercial plant.

"Phase one of the commercial plant could be 50,000tpa capacity, which we want to have ready in 2028. By the end of the decade, we want to have 1Mtpa of capacity in one location, which we could then grow to 3-5Mtpa," said Perras.

In addition to using a wide range of iron ores and removing impurities, its low temperature process means that it can be powered by renewable energy sources such as wind and solar and embrace the intermittent nature of such sources.

"Low temperature means we can turn on and off and take advantage of the interruptible grid. Turning off a process at 900°C is taxing on the equipment. We can turn it off quickly. Being interruptible allows us to be competitive on energy costs, which is opex, and we will be competitive on input costs because we can use a variety of iron ores. Capex will also be competitive as the bulk of the equipment will operate at low temperature and will need less expensive materials to build them versus similar technology," said Perras.

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METALS INDUSTRY UPDATE

JOHN DEERE

Deere & Company, an employer of about 80,000 people, will be cutting its agricultural equipment production in order to fulfill "strategic priorities while reducing overlap and redundancy." Layoffs and early retirements for hundreds of workers is already taking place. Deere reported net income of $2.37 billion in its most recent quarter, down about $490 million year-over-year. Deere's Q2 sales were down 15% and profit suffered a 17% drop.

CHINA

The central government has relaxed mortgage rules and is pushing local governments to buy unsold homes as authorities become more concerned about the real estate market. The new support package will include lower down-payment requirements for homebuyers and $42 billion of central bank funding to help government-backed firms buy excess inventory from developers.



Steel Production Stock Photo

US RAW STEEL PRODUCTION

Year-to-date production at U.S. steel mills is up 2.4% compared to the same period in 2023.

IRON ORE

Iron ore prices are up about 10% since the 2024 bottom marker during early April 2024. Much of this is due to China propping up their real estate market that tends to account for significant amounts of iron ore.

EV NEWS FROM BLOOMBERG

The automotive industry has entered a fiercely competitive phase in the electric vehicle transition, and it's producing a pleasant result for US car buyers: the first long-range EVs that are cheaper to buy than the average gas-powered car. At least three manufacturers offer EVs with more than 300 miles of range for less than the cost of the average new vehicle sold in the US, according to an analysis by *Bloomberg Green*.

SUPERIOR GRAPHITE

n April, it was announced that Superior Graphite had reached an agreement with Unimetal to divest its recarburizer business. Unimetal took over the Desulco trademark and the X-carb brand.

EUROPEAN ENERGY

According to ALeasSoft Energy Forecasting, the Iberian market gave way to France in the month of May as having the lowest electricity cost.

REMs

It was recently announced that Cyclic Materials' Hub100 facility in Ontario, Canada had plans to recycle 100 metric tons of magnetic material per year. The plant is in Kingston, Ontario and will produce recycled mixed rare eart oxides (rMREO) "that can be reused in the rare earth magnet supply chain, as well as nickel and cobalt hydroxides."

RHI MAGNESITA

In April, RHI Magnesita announced their plans to expand its North American footprint by acquiring Resco Group, a U.S.-based producer of alumina monolithics and other basic and non-basic refractories. The price is believed to be $430 million.

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DIGGING THROUGH THE ARCHIVES: PRODUCING SiC



This is the third segment regarding the production of SiC taken from the dusty but irreplaceable archives of ***SiC & More***. This series is dedicated to providing more details about raw materials, new mix, recycled materials, furnace construction, and mobile equipment.

To accomplish the movement of the thousands of tons of materials described in issues #100 and #101 of ***SiC & More***, a fleet of mobile equipment must be maintained. The equipment can be, more or less, divided into to categories. The large equipment often includes a Caterpillar 988 wheel loader fitted with 10 to 14 cubic yard buckets. In addition, the Caterpillar 235 excavator with 3 cubic yard buckets can be seen roaming the furnace yard.

The large equipment can be seen at the mixing station and in the furnace yard constructing furnaces. Smaller wheel loaders and excavators are also used in processing the SiC and for utility work in the furnace yard.

It goes without saying, when working with one of the most abrasive and hardest substances known to man, a comprehensive maintenance program is a must. The program generally consists of machine hours, time charged, materials used, and any special observations about the work performed of the condition of the machine. The program reports on machine availability, service history, operating costs per hour and per ton of SiC, machine history, and oil sampling tests, which are used to monitor machine component wear.

This issue (#102) along with the two previous publications described the construction of a SiC furnace. Issue #103 will include details about the processing of a cooked furnace.



Silicon Carbide & More

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