SiC & MORE

www.SiCandMore.com No. 100/Oct/Nov 2023

3 A Visit with Denfend Wudo Abrasive Co, Ltd

4 Pal Harris Interviews Supply Chain Co-Founder

8 ELSID: SiC Made from Green Energy

9 A Walk Down Memory Lane With Roland Courtmanche

U.S. ELECTROFUSED MINERALS, Inc– Buffalo Division



USEM Buffalo Silicon Carbide Division

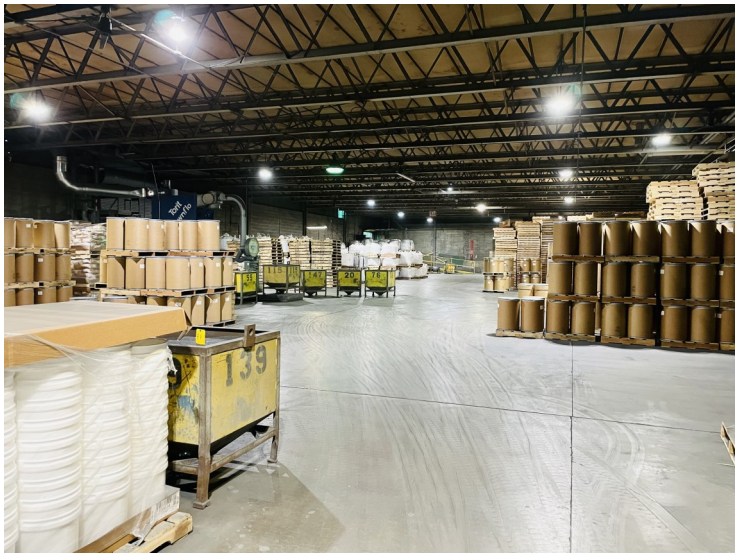
SiC & More recently had the pleasure of interviewing Ryan Van Dusen (Operational Manager of USEM Buffalo Silicon Carbide Division) and Leonardo Curimbaba Ferreira (Managing Director of USEM). The interesting exchange with both gentlemen offered additional insights into what was once known as Electro Abrasives.

U.S. Electrofused Minerals, Inc. – Buffalo Division, formerly known as Electro Abrasives, LLC, has been a unique Silicon Carbide processing facility for almost 40 years. Electro Abrasives Corp. was founded in 1987 after being purchased from the Abrasives Division of Ferro Corp. by Allan Ramming, a divisional product manager at Ferro Corp. Electro Abrasives Corp. was then acquired by Grupo Curimbaba at the end of 2008 and named Electro Abrasives, LLC continuing the legacy of producing the trademark Electrocarb® products.

In October of 2022, Electro Abrasives, LLC was merged with U.S. Electrofused Minerals, Inc. (USEM) and named the USEM Buffalo Silicon Carbide Division. This division is the only one in the United States producing silicon carbide micro grits by water classification achieving a tight cut and highest quality. The USEM Buffalo Silicon Carbide Division also produces regular macro grit sizes (8 – 220) and several types of split sizes, for numerous industries and applications including bonded & coated abrasives, refractories, advanced ceramics, and industrial abrasives.

USEM Buffalo Silicon Carbide Division offers excellent quality, short lead times, competitive prices, and the ability to produce custom sizing. It has the capacity to support small and large orders with a typical lead time of two weeks or less. In addition to the black and green silicon carbides, USEM Buffalo Silicon Carbide Division also offers boron carbide products while the USEM Pittsburgh division offers a complementary range of industrial minerals such as: Brown Fused Aluminas (BFA), White Fused Aluminas (WFA), Pink and Ruby Fused Aluminas, White Fused Mullites, Calcium Aluminate Cements, Magnesia-Alumina Fused Spinels, Activate Bauxites, Refractory Grade Bauxites, Ceramic Grains among other products. In short, USEM boasts arguably the most expansive line of high-quality products, and for a variety of end-use markets, of any organization in North America if not the world.

The management team at USEM is focused on building a team that is committed to continuous improvement, quality, and superior customer service. Leonardo commented, “USEM prides itself in being a reliable source of industrial minerals for the North American market. Grupo Curimbaba is committed to being a long-term supplier with access to its own mines that virtually ensure continuous supply.”



Pictured above is one of the finished goods warehouses at USEM Buffalo Silicon Carbide

© 2023 SiC & More. All Rights Reserved.

FRANCISO BATISTA REPORTS FROM BRAZIL



An issue of ***SiC & More*** is no longer complete unless it includes a report from Francisco Batista in Brazil. After all, according to the International Monetary Fund (IMF), Brazil boasts the world's ninth largest gross domestic product (GDP). Brazil also accounted for $308 billion in exports against $250 billion in imports in 2022. Brazil's largest export partners are China, U.S., Argentina, Netherlands, and Chile while their largest import partners are China, U.S., Argentina, Germany, and India. In addition, as one of the world's leaders in the production of iron ore, copper, gold, bauxite, manganese, tin, nickel, and closer to home silicon carbide, aluminum oxide and ferroalloys keeping current on what is happening in Brazil is a priority.

a) Energy: El Niño is now on its peak and the impact in Brazil is immense. The south region of Brazil is literally underwater while the North region is facing a record drought. The two largest hydro plants in the North Region (Jirau - 3.7GW and Santo Antonio - 3.6GW) were idled last week due to lack of water; still they have very little impact in both the spot and the future energy prices as both plants are run-of-river type. Moreover, the South region's hydros have replaced them operating at full capacity and still spilling over the water excess. Short-term prices continue at regulatory floor price (R$69.04/MWh) and shall remain this way until the end of next rainy season May/24. Future energy prices have shown an irrelevant increase of 3% compared to the last report. The market is still very illiquid for long-term contracts with prices around R$ R$120/MWh ($24/MWh).

b) Macroeconomics: The Brazilian Central Bank has cut interest rate again by 0.5% to 12.25%. A new 0.5% cut is expected for the next COPOM meeting (the last in 2023) taking the rate to 11.75%. FOCUS report projects the interest rate at 9.00% by the end of 2024 and 8.50% by the end of 2025. There are now even more uncertainties regarding the path of interest rates as: (i) GDP is losing traction; (ii) Federal administration has not yet passed any of the promised reforms including tax (the most important) and has recently declared that budget deficit will not be zeroed in 2024 contradicting previous guidance; (iv) FED is potentially increasing interest rates in the near future, and; (v) the Israeli-Hamas war may escalate dragging more nations to the conflict. FX is stabilized around R$ 4.95 but every time bad news arises from Federal budget deficit, FED hiking rates or from the Israeli war front, it quickly jumps to R$ 5.15 level. Current FOCUS projections for Brazilian FX rates are: R$ 4.95 by Dec/23, R$ 5.02 by Dec/24 and 5.10 by Dec/25.

c) Commodities: Average soft and hard commodity prices have leveled off. Future prices are extremely dependent on how Chinese economy will perform and there are a lot of mixed signals coming from there. Brazil is projecting a record grain crop this year totaling 307 million tons of soy, corn, wheat, and sorghum. Exports remain strong across every commodity industry due to favorable FX rate.

d) Politics: President Lula's administration is becoming more and more unpredictable and unreliable as times goes by. There is a clear battle between the ministry of economy (favor federal budget contraction) and the rest of Lula's closest allies (favor federal budget expansion). Although Lula declared full support for the ministry of economy in the early days of his administration, he has recently changed his mind and is now supporting budget expansionism (increasing deficit even further). This is a crucial aspect for the country's future because if the deficit is not zeroed or at least aggressively reduced in 2024 it will certainly bring inflation back pushing FX rate to R$ 5.3+ and interest rates will resume its decreasing path.

© 2023 SiC & More. All Rights Reserved.

A VISIT WITH CHINA'S DENGFENG WUDO ABRASIVE, CO. LTD



Pictured above is the building housing the Denfeng tilting furnace facilities.

SiC & More has had the pleasure of interviewing Dengfeng Abrasive's management team on several previous occasions. Closely monitoring a large aluminum oxide producer in China provides valuable trend data to ***SiC & More's*** readership. If one is producing refractory or abrasive products, keeping current with a world-class producer of brown (BFA) and white (WFA) fused aluminum oxide is crucial.

For review, Dengfeng is located in Dengfeng City, Henan province. The company is privately owned and has an annual furnace capacity of 90,000 metric tons.

In recent years, to comply with ever-stricter Chinese environmental protection regulations, Dengfeng has operated at about 60% capacity utilization albeit the company continues to upgrade their entire production facility. Besides being a world-class smelter of BFA, Dengfeng also processes approximately 20,000 m/t per year of WFA. While BFA is dedicated to both the abrasive and refractory markets, WFA is designated only for refractory. A new processing line for all sizes of BFA and WFA was completed in 2023. The production process is seamless as automation takes furnaced BFA and WFA to jaw crushing, roller crusher, magnetics removal, screening/sieving then to packaging. Now that the state-of-the-art processing lines are complete, ownership is determined to lower the costs associated with fusing BFA and processing both BFA and WFA while improving environmental controls.

Although the processing lines do not currently produce powders, the lines produce both BFA and WFA in -200 mesh and -325 mesh as well as the typical grit sizes 8-220. Ownership, however, is committed to evaluating the costs associated with producing microgrits (powder) if the global demand exists.

When asked about costs, Dengfeng management was direct and echoed what virtually every other global producer of metals and minerals has said of late and that is that kWh pricing has increased. Dengfeng typically pays U.S. 7-8 cents per kWh. Bauxite has been relatively stable during 2023 at U.S. $290 m/t but is still about 15% higher than three (3) years ago. Coke is running about U.S. $213 m/t and electrodes approximately U.S. $2,300.

Dengfeng exports more than 70% of their production and the key markets continue to be Japan, Korea, EU, and U.S.

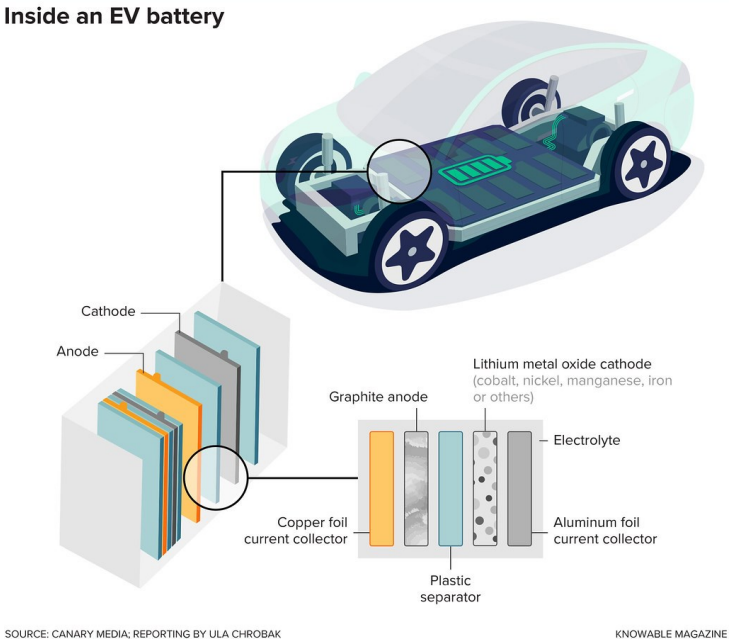
Whereas many smaller furnace plants have closed in China due to lack of economies of scale and environmental compliance, Denfeng has managed to stay ahead of the technology curve. The new processing lines and a commitment to continuously upgrade environmental protection equipment have helped pave a path to the future.



Pictured above is a small section of the Denfeng processing and packaging facilities.

© 2023 SiC & More. All Rights Reserved.

PAUL HARRIS INTERVIEWS SUPPLY CHAIN INSIGHTS CO-FOUNDER



The battery materials universe continues to ebb and flow. ***SiC & More*** spoke with Andy Leyland, co-founder and MD of Supply Chain Insights, a specialist research and consultancy focused on the battery raw materials from mine through chemicals, electrodes and cell manufacturing, to find out more.

S&M What have been some of the highlights of this year?

AL If you go back to 2022, everybody was talking about the explosion in lithium pricing. That's obviously come off the boil, even though we're still at historically high levels. While demand growth is still very strong for the downstream electric vehicles and energy storage systems that support power from solar and wind generation, parts of the supply chain have moved into oversupply. There's too much battery manufacturing capacity; there's too much cathode manufacturing capacity. In some cases, there's too much chemical processing capacity, and that has impacted the inventory cycle, so you've had periods of destocking which have led to lower demand for lithium and lower prices. You've also had a bit more of a supply response on the lithium side, and while the market is still finely balanced, prices have come down, by two-thirds from what were astronomically high levels, demand destruction levels, down to a level where you can still go out and buy an electric vehicle without paying US $4,000 for the lithium in it.

S&M Didn't something similar to this happen in 2018 or is it different this time?

AL It's different this time. In 2018 is, demand was growing 20-25% a year, and you went from 22 to 32 operating assets. It turned out we only needed 31 operating assets. Markets being markets, that led to a three-year price decline. It is crazy to say, but as long as three years ago, we had lithium companies going bankrupt, and that curtailed investment in what we know is a growing market. What is different now is that we're still in a very tight market. Prices haven't gone down below $10,000/t. We're still at $22,000/t. If you can't make money at that level, you probably shouldn't be in this game anyway, so it's not as bad as people think, but it has had a negative impact on sentiment and on equity valuations.

S&M Over the last 18 months, Western governments have increasingly put their money where their mouths are with different financial incentives for different parts of the value chain to encourage the development of battery infrastructure.

AL In many respects, it's a bit of a beauty parade trying to attract parts of the supply chain. Governments are realizing they've made all these agreements for the energy transition which means zero-emission vehicles. Lithium-ion is the winning technology there, hands down, but if that political mandate means shutting car plants in Detroit and moving them to China, that's unacceptable. With the Inflation Reduction Act in the US, they've said you need to have these jobs created in the US or our free trade partners if you want to get access to subsidies, and we're going to open up a lot of debt capital for you in the US, in particular through the Department of Energy loan program office. It's still difficult for the mining side because a lot of the funds available would rather focus on chemical processes and manufacturing facilities, and not extractive industries. There's still a skill set gap across industries to understanding extractive industries. In Europe, you have major investment banks moving away from extractive industries because they lump mining with oil and gas, and they say they are not going to do oil and gas anymore, and they also stop financing copper operations.

S&M Is money going to the right parts of the value chain?

> Next Page

© 2023 SiC & More. All Rights Reserved.

Paul Harris Interview– cont.

Money seems to want to go and build factories and be in production. Mining doesn't move at those speeds as it has a long gestation period before you can turn the key and get minerals out.

AL It's a huge problem. People want to invest in the energy transition and ask what have you got for me? I've got a cobalt mine in the Congo. No, thanks. A lot of the money isn't interested in that, it is interested in buying parts of the supply chain that can be built quicker. You can put a factory up in two to three years, whereas you're looking at seven years plus realistically for bringing a mine onto the market. Enter the critical minerals strategies. There's nothing new there, but we are seeing a bit more government money being deployed into the mining sector. The US has opened up quite a few tax credits and Canada's followed suit. Australia does a pretty solid job as it normally does and some European governments are doing quite well. There is some success on the government side, but we need another source of financing beyond the typical resource financing and governments, and that's the end user because it's the end user who ultimately suffers from higher commodity prices. If the lithium price quadruples, it's Tesla, General Motors, VW, who pay that price. They are starting to get a lot more involved in the sector.

S&M Arguably, the money is going to the wrong part of the value chain. There are all these battery factories and EV factories being built in the US and Canada and there's nothing to put in them because the minerals aren't there. Wouldn't governments fulfil their role better by facilitating projects getting into production in a more expedited manner?

AL Permitting isn't necessarily the problem. The problem you often get are the legal challenges that can set you back and that can mean your financing falls apart or you go through a downturn in the market and you're no longer at the bottom of the cost curve. One thing we've seen success with, is where governments take somebody from the bureaucracy and second them to a project for six to twelve months to walk them through what are often Byzantine permitting processes.

I think it will be the end user who steps in. It is very fresh in the minds of the automakers that they had to stop production because of a shortage of semiconductors. They can see they're moving to a supply chain that they need to encourage to be built. They need to sign long-term offtake contracts. They are not going to start operating mines. It's not their wheelhouse. It doesn't make sense for them, but investing in those operations through long-term off takes that help with financing is the way to go.

S&M Whether gas, diesel or electric, vehicle size continues to grow, which means they consume more materials, consume more energy in their construction, and presumably they produce more emissions because of that. Why aren't governments putting more pressure on automakers or consumers to shrink the size of their vehicles?

AL For batteries, one of the biggest barriers are range and charging anxiety, and you get over that by having a longer vehicle range, which means a bigger battery, which is one of the reasons electric vehicles are SUVs. Governments are not necessarily going to step in here. They do want to make sure the materials are sourced environmentally. You've got the battery passport coming in [in the EU] that makes sure of that. When there's enough charging infrastructure, and people are happier driving electric vehicles, and they don't have that anxiety, they will be able to opt for smaller battery vehicles that will be cheaper and may only get 200 miles of range, but that will be enough when every time you stop, you can plug it in without a hassle.

S&M More lithium mines are coming on stream and the price has plummeted. Is lithium becoming a commodity like any other mineral?

AL Not quite. For something to be a commodity, you need to be able to exchange it with another version of that material and you can't do that with battery grade chemicals yet. You can to a degree with spodumene, but the specialty chemicals are a few years away before they have that. That will happen because we're going to lose provenance of where raw materials come from, because there'll be so much more recycled material coming into the supply chain.

S&M One of the big pieces of news in the space recently was Exxon getting into the lithium business now with direct lithium extraction (DLE) project. Are we seeing a move from a mining paradigm for lithium to an oil and gas paradigm?

AL No, although partially when it comes to geothermal brins. There are two things you need to do to run a successful DLE project based on geothermal brines. The first is well management, particularly when it comes to reinjection of the brine once you've taken out the goodies. That's something Exxon are world leaders at. It makes a huge amount of sense for them to be involved. We've got proven reserves in the Smackover region in Arkansas. Their production target isn't until 2027

> Next Page

© 2023 SiC & More. All Rights Reserved.

Paul Harris Interview– cont.

and that's far enough away that it says to me that they probably don't have all the answers yet to when it comes to what DLE technology they'll use. DLE is a combination of technologies and the brines themselves are not consistent. Exxon are just putting their toe in the water.

S&M Earlier this year, BHP, the large, diversified miner, categorically said it's not going to get into lithium, because it's not a big enough market for it. Exxon is far bigger than BHP, so this isn't going to move the needle for them. So, why are they bothering?

AL For a company like Exxon and some of the other oil majors who have looked at this, they're saying it's a growth sector and do they have skill sets which are deployable? Potentially there's a bit of window dressing and greenwashing, showing they are doing something for the energy transition, but it can also be a reasonable return on the investment and potentially a foot into diversification away from oil and gas in, in many decades time. For Exxon it's small enough that they can throw a couple of billion dollars away and nobody's going to bat an eyelid. If BHP throw a couple of billion dollars away, they're going to have to answer some questions as to why they did that.

S&M Graphite supply is dominated by China, particularly the spherical and spherical coated graphite that the lithium-ion batteries need. There are deposits elsewhere, but it does seem that graphite is a critical overhang on the development of the battery space in the Western world.

AL There are a few markets like this where effectively you've got an oversupply situation in China and an undersupply situation everywhere else. It is very difficult to get financing in that market environment. People want your material, material that isn't controlled by China and potentially a bottleneck in their supply chains. But they need to figure out a way to pay for it. Graphite doesn't operate as a pure commodity market. There isn't an accepted global price for the material. You end up having to go to your off takers to come up with an agreement as to what a reasonable price will be.

S&M What is coming in 2024?

AL You are going to see a lot of negativity around investments in the energy transition, and the energy transition being used as a political tool for electioneering. Underlying that, you're still going to see adoption of EVs, demand growth, and discrepancies in supply and demand develop. The one thing we have relative certainty on is that the demand story is still there and it hasn't gone away. So it's really a supply side story.

Global SiC Prices Continue to Suffer

It was reported in issue #98 of ***SiC & More*** and reiterated in issue #99, "Although worldwide SiC prices are not dropping as dramatically as they did during Q1, there is still a slow incremental erosion taking place that seems likely to continue throughout the balance of 2023." Also in issue #99 a trader commented, "Prices are down with every shipment leaving China, however, a lot of SiC plants in China have been shutdown of late so many believe that supply and demand are basically back in balance. Prices will continue to soften during the balance of 2023, but I expect Q4 pricing to drop in a similar fashion to the past few months, which is in the $5-10 ton range with each ship carrying SiC leaving China. The wild card is if China devalues its currency."

China's economic woes continue thus the respective metals and minerals industries remain soft. With Chinese domestic demand for SiC lower than it has been for many years, and most of the rest of the world's economies in the doldrums, SiC prices have continued to erode. The Chinese made a valiant effort to implement a small increase in early October 2023, however, the market wholeheartedly rejected the attempt. Instead, traders and processors claim that prices dropped approximately 5% in November, depending on the quality of SiC.

The Chinese price erosion is a bitter pill to swallow for most of the world's other furnace plant owners. After finally seeing SiC prices at a level that enables most of the world's producers to make a profit, the 40%-plus drop in prices on most SiC products has forced several of them to reduce capacity especially if energy prices are excessive.

According to one source, current Chinese export prices paid by U.S. traders for refractory and metallurgical grade SiC, are the lowest they have been since May 2021. Abrasive grain prices, however, have been moving south at a slower pace.

End-use market pricing lags the raw material purchased from China by traders and processor by about 3-6 months depending on the amount of inventory processors carry in their warehouses. The timing might be a bit less in the EU vs North America, but they are at least similar.

The global SiC industry can anticipate the Chinese traders and producers to make efforts to increase SiC prices as they approach the Chinese New Year.

> Next Page

© 2023 SiC & More. All Rights Reserved.

ONSEMI PRESS RELEASE

At full capacity, the Bucheon fab will be able to manufacture more than one million SiC wafers annually
onsemi press release: October 24, 2023

What's New: onsemi (Nasdaq: ON) today announced the completed expansion of its state-of-the-art, world-largest silicon carbide (SiC) fabrication facility in Bucheon, South Korea. At full capacity, this fab will be able to manufacture more than one million 200 mm SiC wafers per year. To support the ramp in SiC manufacturing capacity, onsemi plans to hire up to 1,000 local employees over the next three years to fill the mostly highly technical positions – a more than 40% increase over the present workforce of about 2,300.

Why it Matters: Silicon carbide devices are a critical component for power conversion in electric vehicles (EVs), energy infrastructure and high-power EV chargers. The rapidly growing demand for these products has created a surge in demand for SiC chips, with demand outpacing supply for the foreseeable future. The expansion of the Bucheon fab addresses the pressing need for additional production capacity, allowing onsemi to continue to provide supply assurance for its customers and strengthen its leadership in intelligent power solutions.

Construction of the new advanced 150 mm/200 mm SiC fab line along with the high-tech utility building and adjacent parking garage began in the middle of 2022 and was completed in September 2023. The expansion of the 150 mm/200 mm SiC Epi and wafer fab emphasizes onsemi's focus on building out its vertically integrated silicon carbide manufacturing supply chain at brownfield locations. The Bucheon SiC line is starting with the production of 150 mm wafers and will be converted to 200 mm in 2025 upon qualification of the 200 mm SiC process.

Onsemi's leadership was joined by a delegation of dignitaries led by Vice Governor for Economy of the Gyeonggi-Do Taeyoung Yeom; followed by Bucheon City Mayor YongEek Cho; National Assembly delegates; and Bucheon Chamber of Commerce and Industry Chairman JongHuem Kim. Also in attendance were representatives from local communities, customers, suppliers and the semiconductor industry.

Supporting Quotes: onsemi CEO Hassane El-Khoury opened the event, noting, "The 150 mm/200 mm SiC wafer fab in Bucheon is critical to the continued success of our fully integrated SiC supply chain, enabling us to support the acceleration of electrification globally. The last five years have shown what extraordinary performance our Bucheon team is capable of, and what we can achieve when we work together with governmental agencies toward the common goal of a more sustainable future."

"I am truly impressed by onsemi's diligent and yet fast execution of its strategic plan to expand the Bucheon SiC wafer fab," said Bucheon City Mayor YongEek Cho. "Not only will the city of Bucheon benefit from the creation of new employment opportunities in technology, but it will also be a part of laying the foundation for a sustainable ecosystem through electrification."

About onsemi
onsemi (Nasdaq: ON) is driving disruptive innovations to help build a better future. With a focus on automotive and industrial end-markets, the company is accelerating change in megatrends such as vehicle electrification and safety, sustainable energy grids, industrial automation, and 5G and cloud infrastructure. **onsemi** offers a highly differentiated and innovative product portfolio, delivering intelligent power and sensing technologies that solve the world's most complex challenges and leads the way to creating a safer, cleaner and smarter world. **onsemi** is recognized as a Fortune 500® company and included in the Nasdaq-100 Index® and S&P 500® index. Learn more about **onsemi** at www.onsemi.com.

> Continued from previous page

History tells most participants that the Chinese use the two-week New Year's celebration along with the "heating season", environmental police, and currency exchange as a reasons to increase prices. There have been occasions where these tactics have worked, however, there have been just as many years where the schemes failed miserably. Either way, as long as Chinese domestic demand for SiC remains soft, prices will suffer.

© 2023 SiC & More. All Rights Reserved.

ELSID: SiC MADE FROM GREEN ENERGY



Pictured above are super sacks of finished SiC grain ready to ship to customers.

SiC & More last reported on ELSID almost two years ago in issue #91 (January 2022). At that time, management confirmed that the SiC and graphite furnacing operations remained active. A member of the management team added, "All monthly production is sold. The demand is higher than actual process possibilities based on a mix of energy levels possible for the actual period."

As the world of SiC is about to embark on a New Year, ELSID's management responded to ***SiC & More*** inquiries. The company has reduced production due to, "low market demand in the EU zone and Chinese incredibly low-price levels." A manager added, "We make efforts to keep production and commercial activity going during these hard time and provide quality jobs for our employees."

The energy situation in Romania – critical to all SiC furnace plants – remains in good standing with ELSID proud of its reliance on hydroelectric energy. Romania's electricity mix is one of the most balanced in the EU. That mix includes hydropower, coal, nuclear, fossil gas, and wind power. Hydro represents about 28% of electricity production in Romania. According to one source, there were 208 hydrological plants in Romania in 2022. However, despite the use of hydropower at ELSID, the current SiC market does not justify 100% capacity utilization at the Titu and Slatina plants where Elsid can produce 28,000-40,000 metric tons year of SiC and high-quality graphite.

ELSID's management team has been working at improving processing and logistics with emphasis on maximizing energy input while maintaining the same yield and high quality SiC and graphite with each furnace run. The ELSID management also stresses the use of green energy in order to meet their long-time SiC objective of: *MADE WITH GREEN ENERGY*.

According to a key manager, "With experienced shareholder and management teams, ELSID continues to make satisfying the needs of their customers through high-quality products, produced from green energy, as a top objective"

BFA, MgO & More

It was less than two years ago that ***SiC & More*** reported on the pricing upswing of MgO, BFA, bauxite, DBM and FM. Demand exceeded supply and Chinese producers had curtailed or shutdown furnaces and mining operations. Pricing angst was the order of the day.

Pricing seemed out of control and a trader, at that time, told ***SiC & More***, "Many customers in Asia, Europe, and especially in the U.S. suspect that the Chinese are manipulating the commodity markets. I don't know about other markets, however, I am certain that the issues associated with the commodities I follow originate with environmental and energy curtailments or even total shutdowns of furnace or mining operations. The current cost of kilowatts in most of Chinese provinces is similar to what one might have paid in the EU or U.S. during 2019 or 2020. Nowadays prices are through the roof in the EU and many Chinese producers are paying 8 cents per kilowatt assuming they have access to power."

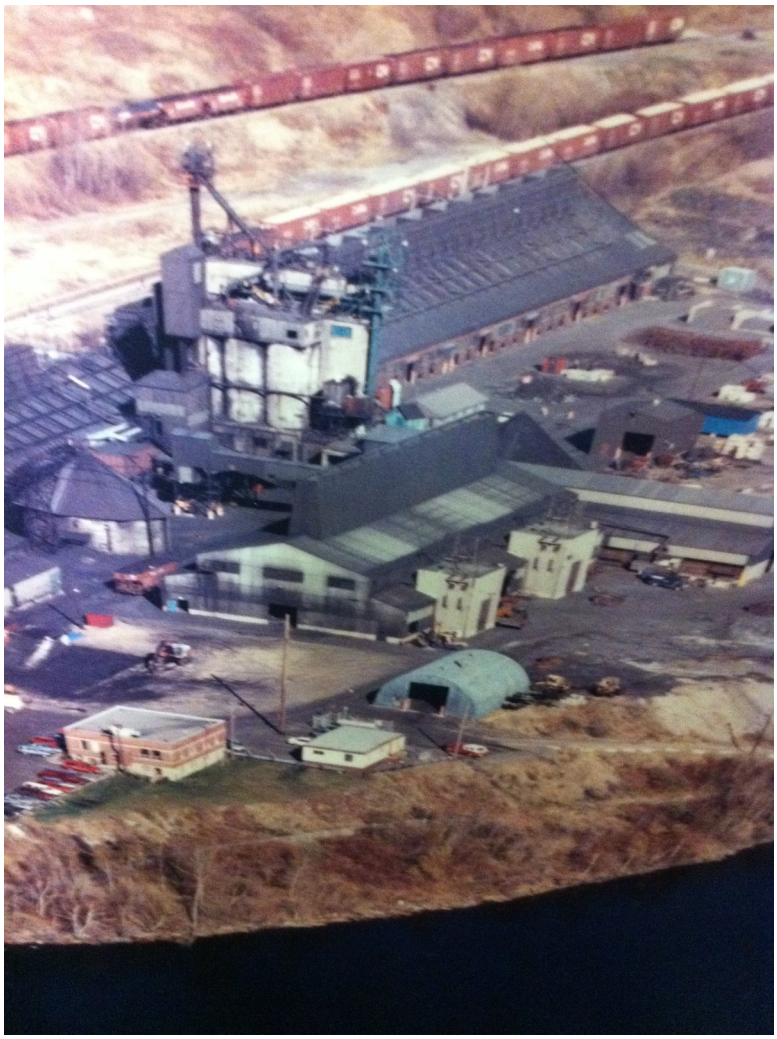
It's interesting how quickly markets can turn the other direction. Bauxite pricing is currently steady. BFA has certainly softened but not as dramatically as SiC. As far as MgO is concerned, one trader told ***SiC & More***, "When it comes to MgO pricing, I believe we are near a 10-year low. The same can be said for DBM."

No doubt, a slowing Chinese economy has contributed to the oversupply and eroding prices. With domestic demand depressed, many expect the Chinese to devalue their currency in an effort to prop up exports.

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 what went up was going to come down. Well, here we are. Stagnant demand, too much inventory, hot competition, and over supply."

© 2023 SiC & More. All Rights Reserved.

A WALK DOWN MEMORY LANE WITH ROLAND COURTEMANCHE



Pictured above is the Shawinigan SiC furnace plant

When preparing to write issue #100, ***SiC & More*** reached out to both several organizations and colleagues, that had a long history in the industry, with the intention of resurrecting several unique and interesting features.

To the rescue came Roland Courtemanche who indulged our writers with an amazing short history of what was once known as Canadian Carborundum. However, we digress and must return to the beginning of this story.

Canadian Aloxite Company launched a fledgling silicon carbide (SiC) furnace plant in Shawinigan, Quebec in 1912. After a few years under Aloxite ownership, the facility was sold in 1916 to Canadian Carborundum; a name familiar to many SiC aficionados. Candadian Carborundum built the first three units, which were 2Mw each and this remarkable facility located not far from the St. Lawrence Seaway and between the beautiful and historic cities of Montreal and Quebec City was on its way to becoming one of the world's great SiC furnace plants.

With inexpensive energy readily available, and both Si sand and pet coke relatively close to Shawinigan, Carborundum added two 3.5 Mw units that included four furnaces each. The year was 1957 and this expansion brought the Shawinigan plant's capacity to 44,000 tons per year making it arguably the largest and most efficient furnace plant of its day.

Standard Oil of Ohio, through Quebec Iron and Titanium, acquired the facility from Carborundum. Not long afterwards, the Shawinigan facility was sold with Norton owning the furnace plant and Washington Mills the SiC grain plant located in Niagara Falls, NY.

Roland Courtemanche is much more than a historian or SiC informational resource. Roland worked at the Norton Shawinigan plant from 1982 to 1997. As Plant Manager, Roland managed the production of 44,000 tons per year of SiC in furnaces that were about 50' long and were loaded with 110 tons of a mix of silica sand and petroleum coke. The plant was unique in its superior recovery of #1 quality SiC vs metallurgical grade. The yield of #1 quality (97%-plus SiC) under Roland's administration reached 80% with the other 20% being metallurgical grade (90% SiC).

When asked about the future of the SiC industry as we know it, Roland said, "I hope that somebody will find a new way to deal economically and satisfactorily with the gases emitted by the furnaces." In addition, Roland made this astute observation. "Having only one furnace plant in operation in North America for such an important material is a bit scary. Keep in mind that SiC was of prime importance during the last world war and the furnace plant in Shawinigan was under army protection during that time."

Sitting down and kibitzing with one of SiC's elder statesmen is always an education. Hearing about the Shawinigan furnace plant was a walk down memory lane and a reminder of the incredibly large footprint that North America once made in the global SiC landscape.

© 2023 SiC & More. All Rights Reserved.

METALS INDUSTRY UPDATE



Panama Canal Stock Photo

PANAMA CANAL

Due to drought, the water levels at the Panama Canal have forced a significant reduction in vessel traffic. The Panama Canal Authority intends to reduce vessel activity by 40% before February 2024. The canal usually moves 34-36 vessels per day through the lanes, however, daily transits stand at 25-29 with the possibility of only 18 ships per day in February.

STAINLESS STEEL

China produced 17.6 million m/t of stainless steel during 1H2023, which represented 62% of the world's total and was an 8.2% increase compared to Chinese production during the same period in 2022. By contrast, stainless steel production in the EU fell by 13.4% year-over-year for the same period while the U.S. it fell by 13.5%.

TESLA

report by Reuters indicates that Tesla will sell 1.8 million electric vehicles before the end of 2023, however, with the emergence of Ford, General Motors, and Hyundai, Cox Automotive estimates that Tesla's share of the EV market has dipped from 62% to 50%.

NUCOR

Nucor recently announced that it is considering potential sites in the Pacific Northwest to build a rebar micro mill. The proposed mill is believed to have an annual capacity of 650,000 tons. Nucor Corp. also announced that it had recorded net earnings of $1.14 billion during Q3 2023. During Q2 2023 the company earned $1.46 billion.

CHINA & GRAPHITE

China is applying restrictions on the shipment of battery-grade graphite to the US, Japan, and EU. Since graphite is the primary material for EV battery anodes and China is the world's largest supplier of graphite, the restrictions are causing angst throughout the industry. Although China's commerce director said the restrictions were "conducive to ensuring the security and stability of the global supply chain and industrial supply chain and conducive to better safeguarding national security and interests", it is believed the decision was retaliation for the U.S. restrictions on semiconductor technologies.

NEXEON

In the UK, Nexeon has been successful in commercializing silicon materials for EV battery anodes. Nexeon is also building a production plant in South Korea and has developed a partnership with battery producer, Panasonic.

WHY ALL THE INTEREST IN SIC FOR EV'S

Silicon carbide (SiC), as a semiconductor, has 10x the breakdown electric field strength and 3x the band gap of common silicon semiconductors, giving it the ability to handle higher voltages with thinner wafer thickness. The higher band gap means that the temperature losses at high temperatures are reduced, making SiC more efficient. For EV's this means that modules can be downsized because SiC's lower electrical resistance, peripherals, can be downsized because of its faster operation, and its ability to operate at higher temperature and lose less waste heat means no so much cooling equipment is needed. (Sources *Battery Materials Review* and *Design & Elektronik*)

NICKEL AND INDONESIA

Indonesia and China currently make up 70% of global supply and demand, however, the resource boom in nickel is mostly taking place in Indonesia. Indonesia accounts for 55% of current global supply and is expected to grow to over 70% in the next five years. (Source *Fastmarkets*)

IRON ORE

Recent spot prices on iron ore represent the highest prices since late March 2023. Price quotes for the first weeks of November were in the $125-127 m/t range.

> Next Page

© 2023 SiC & More. All Rights Reserved.

METALS INDUSTRY UPDATE-cont.

EXXONMOBIL & ELECTRIC VEHICLES

ExxonMobil intends to start drilling for lithium in southern Arkansas during 2027. Demand for electric vehicles is expected to continue to grow in the coming years and lithium is essential to electrification. Exxon officials said they expect lithium demand to quadruple by 2030.

MACHINE TOOL ORDERS

Through the first nine months of 2023, machine tool orders in the U.S. totaled $3.64 billion, which is 13.8% less than the same period last year. According to Douglas K. Woods, President of the Assn. for Manufacturing Technology, “Through 2023 orders are down, activity is still above long-term historical averages, indicating relative healthy overall.



Boeing 777 Stock Photo

BOEING & EMIRATES

Emirates Airline recently expanded its order of Boeing wide-body jets to 205 units. The company booked a reported $52 billion order with Boeing for 95 new jets bringing the total to 205. Emirates is the largest operator of the Boeing 777 aircraft.

CATERPILLAR

press release: Caterpillar will use a demonstration project funded by the U.S. Department of Energy to build a hydrogen-hybrid power solution on its C13D platform. The three-year project will begin in the first quarter of 2024 with the goal of developing a transient-capable system for off-highway applications. The project will demonstrate how state-of-the-art control systems and electric-hybrid components can help hydrogen-fueled engines meet or exceed the power density and transient performance of traditional diesel engines, according to the company.

Heraeus Acquires Stake in Start-Up Zadient Technologies SAS

* Press Release

The Hanau-based technology company Heraeus has acquired a significant stake in the start-up company Zadient. Heraeus, as a German high-tech materials player considers the market of SiC base material highly relevant and a suitable addition to its other operations.

The French-German firm Zadient specializes in the production of silicon carbide source material. Silicon carbide is a wide band gap semiconductor material, which is currently gaining rapid traction in the semiconductor market. Its properties lend themselves to use in power semiconductors, which help to convert current and voltages. Its fundamental contribution is the dramatic increase in efficiency it provides over silicon by reducing the heat losses that occur while power passes through chips. Its ability to handle higher power densities with low losses allows for the transition from 400V to 800V battery systems in EVs which significantly shortens their charging time and increases their range. SiC based electronics are also smaller and lighter, which also contributes to increased range. These properties have lead to the rapid adoption of SiC in applications ranging from the main inverters and on-board chargers in EVs to wind and solar power inverters, battery storage systems and even airplane power management modules. The breadth of these few examples is already an indication of the significant role SiC will play in the mobility and energy transition.

Through the partnership, Heraeus intends to accelerate the company's growth and support Zadient's innovative approach with its own know-how.

Zadient high purity silicon carbide source material
"Heraeus recognizes the potential of the SiC market and considers it to be highly relevant for high-tech applications. By acquiring a stake in Zadient, we can jointly offer our customers even better solutions" said Steffen Metzger, member of the Heraeus Group Management Committee. “We are very happy that we found a way to accelerate growth in the SiC market by combining the innovative ideas of the materials start-up Zadient with the manufacturing and technical expertise of the Heraeus Group.”

“We are very excited to be partnering with an industry leader like Heraeus,” noted Zadient CEO Kagan Ceran. “The expertise that Heraeus has in the industrial scale production of advanced materials, both in its home market of Germany and abroad, offers us unique synergies as we strive to realize our vision to be the world’s largest volume, highest purity producer of silicon carbide semiconductor materials.”

© 2023 SiC & More. All Rights Reserved.

NEWS FROM ZAPORIZHABRASIVE IN THE UKRAINE



Customer orders being staged and loaded for dispatch out of one of the Zaporizhabrasive warehouses.

As we celebrate our 100th issue of ***SiC & More***, we reflect on reporting the trials and tribulations of ZAK in 2003 as the company fought to exit the penalty box when it came to trade with the U.S.A. Due to the US Trade Representative (USTR) placing 100% ad valorem duties on virtually all Ukrainian exports ZAK was unable to export to the U.S., but still managed to increase production while it waited for the duties to be lifted. When the USTR lifted the duties due to the Ukraine government adopting improvements to its legislation protecting intellectual property rights, ZAK was poised to ship value-added products to the U.S.

As we prepare to exit 2023, ZAK continues to battle against all odds while producing grinding materials in the middle of a war zone. In issue #99***, SiC & More*** reported on ZAK implementing an ambitious enterprise modernization strategy. This step aimed to expand the company's capabilities, enhance competitiveness, and provide convenient access to information for clients and partners.

Since issue #99 of ***SiC & More***, the Zaporizhzhya Abrasive plant has invested over US $800,000 in Genton equipment to improve feeding and mixing of charge materials for the furnace. The capex project was approved in 2022 and the work was launched on November 1, 2023.

Oleksandr Shkola told ***SiC & More***, "The main advantage of the new equipment compared to the old one, is to improve the quality of mixing charge materials and high dosing accuracy." In addition, "High quality mixing of all materials and exact adherence to the recipe is the basis of process stability and obtaining the necessary indicators."

According to Shkola, the new system virtually eliminates human error in the technological process of mixing components for furnacing SiC and only technical people have access to process management.

Shkola added, "It is expected that the use of this equipment will further improve the quality of finished product, increase productivity, and save raw materials."

During recent conversations with ZAK's customer service personnel, ***SiC & More*** was informed that the facility has overstock on several SiC and BFA products. For example, on BFA abrasive grain, ZAK has excess inventory of F14, F20, F22, F36, F40, F54, F70, F90, and several finer sizes. On SiC, the overstock is a bit limited but excess material exists in F20, F22, F30, F36, F40 and F46. Since the availability of abrasive grain can change day over day let alone month over month, one can reach out to ZAK at

i.tokarev@zak-abrasives.com
l.gordiy@zak-abrasives.com

> Continued from previous page

About Zadient

Zadient is a start-up company with headquarters in Chambery, France, and another production facility near Leipzig, Germany. The company manufactures high-purity silicon carbide source material through the Chemical Vapor Deposition (CVD) process and also develops technologies for high-yield large-diameter crystal growth. Zadient's mission is to help remove materials bottlenecks in the silicon carbide semiconductor value chain and accelerate the wide-spread adoption of this highly energy efficient technology in the Electric Transition.

© 2023 SiC & More. All Rights Reserved.

DIGGING THROUGH THE ARCHIVES: PRODUCING SiC

It's always an adventure locating old papers in your library and the discoveries can often be enlightening. Some discoveries, however, are simply common-sense reminders that are interesting to share. This is the seventeenth segment from the dusty but irreplaceable ***SiC & More*** archives. The literature that we pull from the archives makes it apparent that the evolution of the business often goes unnoticed. On the other hand, other discoveries remind us that some elements of the business haven't changed all that much. The following is the initial segment on producing silicon carbide. After collaborating with several colleagues, it's apparent that most of the process described in the next few issues represents elements of the business that haven't changed all that much.

When furnacing SiC, there has been a somewhat methodical evolution from the traditional furnace hall format, with small side-by-side furnaces located within a building, to what the industry refers to as large furnaces. The primary issue associated with small furnaces was the difficulty in achieving effective gas collection and the small furnace footprint required extensive labor.

The large furnace technology was launched by ESK approximately 50 years ago. This style of furnace allowed for practical and economical pollution control. The production output was superior to small furnaces and the larger one yielded nearly 15 times the SiC of its smaller brethren.

The large furnace option is less labor-intensive and material movement is on a much larger scale and over a much larger area. For easy calculating, let's use a 100,000 ton per year furnace plant as an example. To operate a facility of this size, it is necessary to move tens of thousands of tons of raw materials such as silica sand, petroleum coke, graphite, new mix, recycled mix, as well as SiC in various stages of production. Some of these movements are as long as 500 yards. Imagine doing that sort of movement without large mobile equipment like what is used in the construction and mining industries. The small furnace technology inside a furnace hall limits the size of heavy equipment that can be used, which means increased costs in labor as well as increased wear and tear on equipment caused by smaller loads not to mention the incredible inefficiency.

Typical material movement over the course of a year would look something like this:

- 330,000 to 360,000 tons of raw materials (for the mixing station)
- 260,000 to 290,000 tons of new mix materials (for the furnace yard)
- 110,000 to 120,000 tons of recycled materials
- 100,000 tons of SiC moved in various stages of production.

In issue #101 of ***SiC & More***, we will elaborate on the raw materials, new mix, recycled materials, furnace construction, and mobile equipment.



Pictured above is the final layer of raw material being loaded on a Sublime furnace using a sophisticated rotating loading conveyor.

Watch for issue #101 when SiC & More reviews highlights of the past 20 years and 100 issues!

Silicon Carbide & More

Publisher: Kormac Kennedy Editor: Marissa Decklin. Copyright information: Copyright © 2018 by Silicon Carbide & More Inc. All rights reserved. Information contained in Silicon Carbide & More may not be redistributed, reproduced or put into an information retrieval system without prior written permission. *Silicon Carbide & More* is published five-eight times per year. Subscriptions: US$375 per year for a single user; US$475 per year for a multiple-user company subscription. For more information call +57 321 720 1537 or email kormackennedy@aol.com. Silicon Carbide & More, PO Box 503, Glen Ellyn, IL 60138-0503. Information contained in *Silicon Carbide & More* has been obtained from sources believed to be reliable but due to the possibility of error by *Silicon Carbide & More*, or others, *Silicon Carbide & More* does not guarantee the accuracy, adequacy or results obtained from the use of such information.

SiC Feedback & News line

Our staff is dedicated to seeking out the information you need to stay on the leading edge of silicon carbide and related businesses. Please email industry news, press releases or details of other events of note to us at the address below. If there are specific supply issues or topics that you would like to see discussed in future issues of *Silicon Carbide & More,* please email your ideas to us at:
kormackennedy@aol.com

www.siliconcarbideandmore.com

© 2023 SiC & More. All Rights Reserved.