Foundries fire up a gear

Automotive markets are giving foundries the drive they need to recover from recession, but western foundries will have to tap into specialised products to compete with developing countries' heavy industries

Jessica Roberts, *Assistant Editor*

To onlookers, the world foundry industry has received something akin to a jump-start this year. Like other markets directly related to industrial activity, the foundries sector followed the downturn seen in construction and refractories markets in late 2008 and the resulting stagnation in 2009. But its fall was not as pronounced as that of other markets like ceramics and refractories, and 2010 has seen some true demand return to the sector – largely from automotive industry, its biggest end market.

Park of this jump-start comes from the protection afforded by China through its insatiable hunger for industrial development. The Asian country's castings output accounts for more than a third of global production, which totalled almost 60m. tonnes in 2008.

Without China's production, *Modern Casting* estimates that castings production would have contracted by as much as 5.8% in 2008 – far more damaging than the actual 1.5% contraction the market saw, owing to China's astonishing 7% growth in castings output that year.

Other success stories of the recession include Brazil, South Korea and Poland – all of which made production gains between 1.6-4% in 2008. One of the most surprising victims of the downturn was India – which over the last five years had been the fastest growing of the large casting-producing countries – whose output fell by almost 13% to 6.8m. tpa.

Two other notable victims were Japan and the USA – both important countries for foundries – which suffered casting production falls of 18.8% and 8.8%, respectively. Like many markets, influences on demand are largely regionalised and some of these regions are still struggling to regain pre-2008 production levels.

"The global economic crisis had a significant effect on all types of foundries," Joe Howden of Amcol International Corp. told **IM**. "The immediate impact of the crisis was on short lead time castings, ie. automotive foundries, which then steadily filtered through to the more specialised segments of the industry producing infra structure castings."

In addition to falling automobile demand, large infrastructure projects were cancelled or postponed in many countries – particularly in Eastern Europe (*IM June 2009: Eastern Europe's construction market tumbles*).

"Although governments around the world said they would bring forward infrastructure projects in order to spend their way out of the crisis, the majority of these projects have as yet not materialised," Howden commented.

Of course, the foundries market is itself a huge end use sector for myriad industrial minerals; many of which are also used in the related markets of refractories and metallurgy. For these minerals, the effects of the recession are still being felt – and will probably continue to be felt well into 2011.

Chromite

Four main minerals are used as molding sands in the foundries market; silica sand, chromite, olivine, and zircon (*see panel*). Silica sand is the most widely used foundry sand owing to its high availability and low cost, while other, more expensive sands, find applications in niche castings markets.

Traditionally the use of chromite was reserved for manganese steel castings, but the mineral has gained more acceptance in a wide range of ferrous and non-ferrous castings, and is now commonly used to face large castings or thick sections.

For chromite, the effect of the recession was a disruption of mine supply and inventory levels that suppliers are still battling to correct.

"The current challenge is supplying the foundries with raw material," Zelda du Preez, CEO of South Africa's Rand York SA, told **IM**. "All foundries were running with minimum inventory levels and surviving on 'just in time deliveries'. The ramp up in business has left many suppliers without stock."

Crucially, South Africa – the world's largest producer of chromite – has faced difficulties with striking workers at a time when its companies are already struggling to get material to their customers through a disrupted supply chain. In May a number of chromite producers, including Xstrata Plc and Samancor Ltd, declared *force majeure* on shipments from the country.

"The impact of the South African strike with our transport unions saw more than 50,000 workers not loading containers or bulk shipments of ferrochrome and chromite sand," du Preez explained.

Striking transport workers were then joined by workers from the state-owned power utility, Eskom, later that same month.

Foundry minerals at a glance

Foundry sands

Silica sand is the principal foundry moulding material owing to its widespread availability and low cost. Fine, naturally bonded sands have traditionally been used in the casting of aluminium, light copper alloys, and light grey iron. Heavier, naturally bonded sands are used in the molding of large iron castings. Applications for all naturally bonded products have declined in favour of blends of washed sands, bentonites and other binders and additives, owing to better control and customisation of product characteristics. **Pricing:** $18-20/tonne for Vietnam material, FOB DaNanag.

Chromite sand has been used in foundries for over 50 years and has steadily expanded its end market from manganese steel castings to a wide range of ferrous and non-ferrous castings, and is commonly used to face large castings or thick sections. Improvements in product quality and consistency and the incompatibility of olivine with many synthetic binder systems have boosted chromite's market penetration. **Pricing:** $310-360/tonne for South African material, wet bulk, FOB Transvaal.

Olivine sand is widely used in the casting of manganese steels due to its basicity. The magnesium content of the olivine enhances its bonding characteristics when used with clays, reducing bentonite usage. It is also used in the production of castings (particularly non-ferrous) that require a fine surface finish as well as in core manufacturing. Olivine has faced competition from chromite sands as producers have improved the quality of their foundry grades and have benefited from olivine's incompatibility with acid-cured binders. **Pricing:** $60-90/tonne for US material (refractory grade), ex-mine.

Zircon sand is a niche product that is capable of withstanding long exposure to the highest casting temperatures – typically between 1,550-1,650°C for certain low alloy and low carbon steels. Its unique characteristics (such as refractoriness, low linear thermal expansion, and chemical stability) make it an ideal non-silica foundry sand. But high prices mean it is usually reserved for the most specialised applications; such as facings for heavy iron and steel castings poured at high temperatures, as mold paints or washes to improve surface quality, high definition cores, and shell casting and investment casting. **Pricing:** $825-860/tonne for Australian material, standard, bulk, FOB.

Other lesser-used sands include: andalusite, bauxite, ilmenite, kyanite, mullite, perlite, sillimanite, fused silica and staurolite.

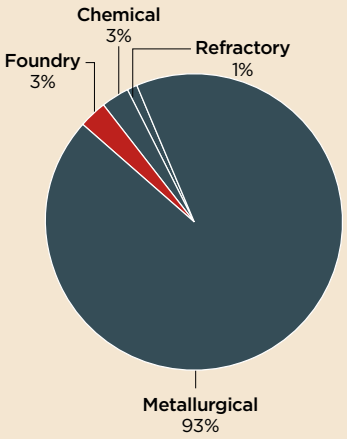
Foundry additives

Bentonite has good bonding characteristics and fast green strength, good hot strength, high gel formation and low permeability. It is used to bind green sands (such as olivine) together during foundry molding and metal casting. Both calcium and sodium bentonites are used in foundry applications, although Na bentonite is more stable at high temperatures – such as those encountered during casting of steel, ductile iron, and medium-heavy grey iron. Ca bentonite is more commonly used for detailed intricate castings, usually with grey iron, ductile iron, and non-ferrous alloys. **Pricing:** $90-115/tonne for US material, bagged, ex-works Wyoming, railcar.

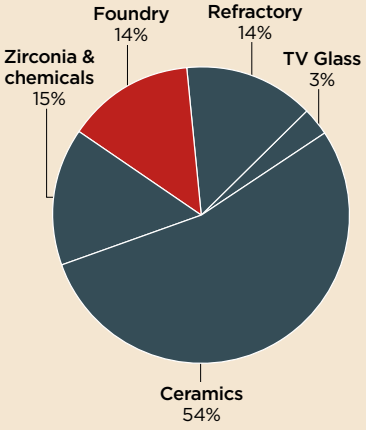
Graphite is traditionally used in core and mold washings and foundry ladles. Low quality flake graphite or amorphous flake graphite can be mixed with other refractory minerals and shaped to form crucibles, molds and ladles for multiple metal types. Finely ground flake graphite or amorphous graphite can also be used with other minerals to form foundry facing or coating for molds – creating a smooth finish on castings. **Pricing:** $700-900/tonne, CIF European port, FCL Crystalline medium, 85-87%C, +100-80 mesh.

Other additives include alumina (fused and white fused), gilsonite, kaolin and mica.

Chromite

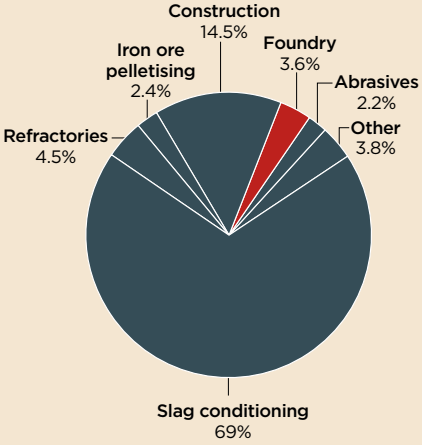


Zircon



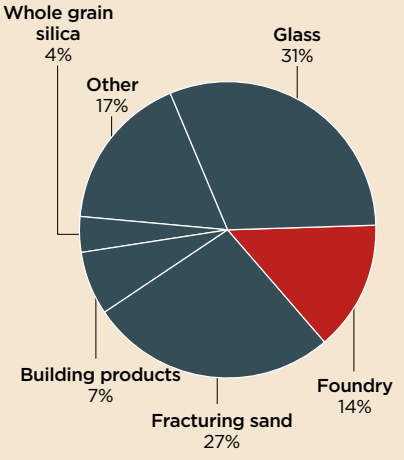
Source: Iluka Resources Plc

Olivine



Source: Industrial Minerals HandyBook, 4th ed.

Silica sand*



*US markets

Source: USGS

Du Preez revealed: "Foundries were forced to use alternative minerals such as zirconium silicate, olivine or rutile. The other option was to change the processes and try to eliminate the use of chromite."

Chromite investments

South African chromite supply looks set to be boosted by a $50m. investment from US foundry minerals producer, Amcol International.

As part of its investment Amcol is building a new chromite processing facility at its Ruighoek Chrome project in North West Province which, at the time of press, is expected to be completed by early July 2010.

The facility, which will be the supply base for Amcol's new foundry chromite brand *Hevi-sand*, will offer "mine to customer" supply of customer-specified products with local onsite customer technical support.

"Our technology will allow us to offer a tailor-made product to the foundries, offering higher chrome contents, lower silicates levels and sized to the foundries' requirements," Amcol's Joe Howden told **IM**, adding that the current chromite supply situation is, in most instances 'take it or leave it'.

As Howden explained, historically in developed countries foundries have tended to be clustered into industrial centres which create identifiable focal points for supply companies, raw material stocks and logistics trains, allowing lower cost and just in time supply. With more foundries being closed in developed countries and opening elsewhere, industrial centres have been lost.

"When this is coupled with falling local demand, and many products and minerals being imported from developing countries, 'just in time' and local stock holding has become more and more costly and difficult to achieve," Howden commented.

The Ruighoek facility is part of Amcol's response to this problem. The group has numerous subsidiaries and offices worldwide, which will allow it to supply its own chromite from mine to customer, with technical staff to support foundries at site.

Also looking to break into the foundry minerals market is US company Oregon Resources Corp. (ORC), a wholly owned subsidiary of Australian company Industrial Minerals Corp. (IMC), which has been steadily cultivating a heavy mineral sands deposit in Coos Bay, Oregon (*see p.45*).

The deposit hosts a suite of minerals including foundry grades of chromite, high-iron ilmenite, and zircon, but with a twist: the chromite will sold as a premium chromite grade but also as a zircon replacement.

"We see the opportunity to introduce a differentiated product and value proposition to the foundries that are looking to improve their end product quality and save money by reducing the after-casting workroom cost and rejects," IMC chief executive, Philip Garratt, told **IM**.

"Since our product is a speciality sand our opportunity and initial focus is to capitalise on the pricing of other speciality sands such as bauxite, mullite and zircon, as our material will be a lower cost substitute for these products," Garratt explained to **IM**.

Breaking into an established market as a new supplier poses problems of its own, although the company's decision to market its chromite as speciality sand will see it competing with more expensive products – a factor that should prove to be an advantage, if the product can gain market acceptance.

"As any marketer of a new and innovative product will testify, changing the status quo is often the most difficult challenge despite the improvements in environmental performance and value proposition the new product may offer," Garratt revealed. "The foundry industry has been doing it the same way for years with process changes and/or product improvements taking several years to be tried and ultimately adopted."

A significant part of the challenge is building partnerships with established suppliers, certainly something ORC has already achieved: US foundry supplier HA International Inc. will be responsible for selling ORC's chromite to North American markets, IGC Technologies LLC has secured exclusive distribution rights for the high-iron ilmenite, and German minerals trader Possehl Erzkontor GmbH will be handling chromite sales to Europe.

HA International (HAI) CEO Keith McLean told **IM** that part of the attraction to the project was the "untraditional" nature of the deposit: "ORC chromite is a unique product. It's not just a commodity and it has some very specific and valuable attributes that the South African material doesn't."

HAI is looking to sell the chromite to two main markets: the conventional chromite market and the realm of zircon replacement – where the material will be a lower cost alternative.

"The natural market for this chromite is North America; that's where it's sourced and that's where you'll get the best economics," McLean explained. "Unfortunately I don't think there's enough demand here to absorb the capacity of ORC's plant, but we'll sell as much as we can to Canada, the USA and Mexico."

One benefit of the ORC chromite is its round grain shape, which allows producers to reduce the amount of resin needed in the mold formulation. "Using less resin has implications for emissions and product price. If you can cut your resin usage by 30-40%, along with that goes a 30-40% reduction in emissions. And emissions are a problem for every foundry, everywhere in the world," McLean revealed.

Additives: graphite

One of the principal end uses for graphite is in foundries, where the refractory mineral finds a number of applications. Graphite is commonly used as a foundry facing or mould wash, aiding the removal of cast metal after the product has cooled. Similarly, graphite can be used to lubricate extrusion dies before hot metal is reshaped. Owing to its high carbon content graphite is frequently used in foundries to raise the carbon content of hot metal.

For graphite, the recession was a period of price instability and supply disruption – compounded in late 2009 and early 2010 by poor weather conditions in China and the country's government placing further limitations on production, resulting in mine closures (*see p.31: The bright side of graphite*).

"Many products produced in foundries are for the automotive market. This is why the foundries have suffered along with the automotive producers. Prices for steel and aluminium also made the situation even worse," Thomas Junker, director of sales and marketing at Germany-based graphite company, Graphit Kropfmühl AG, told **IM**.

This year GK expects to increase graphite sales to the foundry sector by up to 25%, bringing them back to the sales volumes seen in 2008. The company is currently developing graphite dispersions based on vein graphite for foundries. These products are aimed at supporting the flow of liquid metal, increasing form filling.

"The challenge is to provide high quality products at a competitive price level," GK's Junker told **IM**. "Supporting the customer on site to optimise the use of the product and also to develop tailor-made solutions often makes the difference."

Prices for graphite are beginning to recover to higher levels and are largely being accepted by the market. In June, Austrian graphite miner Graphit Bergbau increased prices for the first time in over three years in an effort to pass on the increasing cost of production to customers. After temporarily suspending production at its mine a few years ago, the company had been supplying customers from stockpiles and only within the past year has it resumed mining.

"Like in many other business segments, the price of foundry grade graphite is controlled by demand and availability," Junker commented. "Until now prices have been quite stable, but we see an increase driven by

Oregon Resources: a new source of foundry minerals

IM talked to **Philip Garratt**, CEO of Australia's Industrial Minerals Corp. – the parent company of Coos Bay's heavy mineral sands developer, Oregon Resources – about its progress at the US-based project and the flagship product of the heavy minerals mix: chromite.

IM: What stage are you at with the Coos Bay project?

PG: We have commenced the construction of the main processing facility and expect foundation formwork to be completed by mid-June 2010. The construction of the wet and dry mill and all related components is scheduled for completion in January 2011.

We have just undertaken a drilling programme on recently acquired leases and we expect assay results will be available by late September 2010. The areas drilled are contiguous to our existing resource and I expect to see assay results comparable to the surrounding leases. We are hopeful that by the current year-end we will be able to demonstrate a resource sufficient for a minimum 20-year mine life.

IM: Who are the main partners involved in the project?

PG: We have a close working relationship with the minerals division of Weyerhaeuser Corp. [US timber company] and they are the principal landowner and benefit through royalty and lease payments. The main project owners are Macquarie Bank –Metals and Minerals division and The Sentient Group. Together they own approximately 45% of the fully diluted capital of Industrial Minerals Corp. which is the 100% owner of Oregon Resources Corp.

HA International, IGC Technologies, and Possehl Erzkontor are our primary collaborators in the project and we appreciate their involvement at various levels of the business.

IM: When do you expect to begin mining and what are your short- to medium-term plans for the site?

PG: Mining will commence early in the fourth quarter [2010] to provide feed for the start-up and commissioning of the wet plant later, in the same period. The mining plan involves the removal of surface material and extraction by front end loaders of ore onto trucks for transportation to the processing site.

There are multiple contiguous deposits and the time taken for extraction of the valuable heavy minerals varies per deposit. The surface area operated on at any one time is approximately 5 acres with extraction from 2.5 acres, while contemporaneous reclamation is undertaken on the recently mined 2.5 acres. The land is reclaimed in accordance with the requirements of the land owners; principally Weyerhaeuser Corp.

IM: Which regions are you targeting for sales of chromite, high-iron ilmenite and zircon?

PG: Chromite will be sold into the North American and international markets; approximately 40% into North and South America, 40% into Asia, and the balance to Europe. The high-iron sales will all be to IGC Technologies LLC, while 100% of zirc on sales will be into the USA.

IM: What are the main properties of Coos Bay chromite? How does it differ to other chromite sands?

PG: ORC's chromite was deposited in ancient beach terraces which have since been uplifted to their present level. Due to the ocean's wave action, these mineral particles have been rounded, polished, separated by specific gravity and classified into a very consistent, narrow, two sieve size distribution, with an 85 to 90 AFS grain fineness number.

A common or typical chromite sand is crushed from agglomerated grains and chromite ore. The resulting crushed sand will be angular, due to the crushing and the crystalline structure of the chromite mineral, and it will be a four sieve distribution with an AFS grain fineness of 48 to 51.

Foundrymen are used to the wider, four sieve distribution and are usually nervous about using a narrow distribution sand, because they feel the wider distribution will allow the finer grains to fill the voids between the coarse grains and provide a better casting finish.

However, ORC's sand has a rounded grain shape and narrow particle size distribution, which allows the rounded grains to pack together tightly; providing increased grain-to-grain contact and therefore increasing the contact points for the binder to form more binder bridges, with more adjacent grains. Due to these properties we have observed higher tensile strength for the cores, improved heat transfer and an improved casting finish.

Philip Garratt, CEO of Industrial Minerals Corp.

Additionally, the clay content of ORC's chromite is half that of South African chromite sand. Crucially, a high clay content can cause the binder bridges between sand grains to fail. This occurs when the binder bridge between the sand grains is stronger than the bond to the sand's surface. Adhesion failure results from the binder peeling away from the surface of the sand grains, and is typically caused due to a coating on the surface of the sand – such as clay – that impedes the ability of the binder to adhere to the sand's surface.

If the surface of the ORC chromite is not clean, the electrostatic separators, low intensity magnets and rare earth magnets will not be able to effectively separate the various minerals, meaning the product would fail all of the established quality testing parameters

and the sand would have to be discarded or reprocessed. So binder bridge failure due to an unwanted coating on the sand grains is not a factor for ORC chromite.

IM: What are ORC's challenges and opportunities in the foundry market?

PG: Challenges that we faced as we looked to position as a new supplier to this market ranged from establishing relationships with customers, through to logistical issues. These have been significantly addressed by the creation of working relationships and partnerships with several well established and respected foundry supply businesses. Since our product is a speciality sand our opportunity and initial focus is to capitalise on the pricing of other speciality sands such as bauxite, mullite and zircon, as our material will be a lower cost substitute for these products. The opportunity for zircon substitution in foundries is mainly outside Europe as European foundries experienced pricing and supply challenges earlier in the decade and migrated to readily available cheaper alternatives.

We see the opportunity to introduce a differentiated product and value proposition to the foundries that are looking to improve their end product quality and save money by reducing the after-casting workroom cost and rejects. We see the potential to collaborate with existing producers of conventional foundry chromite sand and introduce new exclusive blended product lines. We have created castings with blended material and documented the improved performance characteristics and shake-out. We see potential to introduce unique blended chromite products to the market in the future and would expect demand to be stimulated post the introduction of our premium grade offering.

I believe foundries will need to become much more efficient- and quality-oriented in [developing] regions and will not be able to afford the time and money currently wasted on scrapped castings as well as labour in the workroom rectifying casting defects. I expect it will take some time for change to occur, as the misconception is that a $1 saving on casting sand is $1 saved. In fact, buying quality casting sand can reduce the percentage of scrapped castings and time taken trying to clean up and grind a casting to meet customer expectation.

Selected new foundry mineral projects

Company	Mineral	Location	Comments
Amcol International Corp.	chromite	North West Province, South Africa	new chromite processing facility at Amcol's Ruighoek Chrome project will be the base for the group's new *Hevi-sand* foundry chromite grade and distribution service. The facility is part of a $50m. investment, which includes the majority share purchase of Bonmerci Investments 103 Pty Ltd – itself in turn the majority shareholder of Batlhako Mining Ltd, which owns Ruighoek.
Amcol Minerals Madencilik	bentonite	Enez Edirne, Turkey	new subsidiary of Amcol Minerals Europe with 150,000 tpa bentonite capacity. "Most attractive" markets for AMM include foundries and metal casting.
Askania, North Cape Minerals	silica sand	Spone, Norway	following their merger in January 2010, Sibelco subsidiaries Askania and North Cape Minerals have invested $6.8m. in a new silica sand processing plant, to be built in Spone where Askania's existing warehouses are located. The project is scheduled for completion in late 2010 or early 2011.
Chromex	chromite	Stellite, South Africa	mining metallurgical grade but planning to produce foundry and chemical grade chromite
Cliffs Resources, KWG, Noront Resources, Spider Resources	chromite	Ring of Fire, Ontario, Canada	the Ring of Fire area in northern Ontario has been a hive of activity in the past few years, with much of the attention focused on the Big Daddy chromite deposit – majority-owned by KWG and Spider, with Cliffs holding 49%. In 2009 the US group successfully outbid Noront to buy Freewest, giving Cliffs access to the property. Recently it launched a bid for chromite junior Spider. Regardless of who ultimately develops this area, it contains significant reserves of metallurgical and non-met chromite. Also promising is Noront's neighbouring Blackbird deposit.
Gulf Mining Materials Co.	chromite	Wadi Mahram, Oman	Oman's first chromite processing plant, opened by Gulf Mining in February 2010, with 15,000 tpa capacity. Aiming to supply non-met grades for abrasive, foundry and refractory uses.
Iluka Resources	zircon	New South Wales and South Australia	the world's largest zircon miner, Iluka is presently shifting its production base to two new projects: Jacinth-Ambrosia in South Australia, and Murray Basin 2 in New South Wales. The former is expected to produce 300,000 tpa zircon, while the latter (brought online in late 2009) is targeting 120,000 tpa.
Jonkel Group	graphite	Limpopo, South Africa	company owns three graphite deposits, including Steamboat deposit which has a grade of 8.8% of 2mm disseminated flake graphite. Targeting production by end 2010. If successful, Jonkel would be South Africa's sole graphite producer. Initial production would be small (100 tpa purified graphite).
Laviosa Sanayi ve Ticaret Ltd	bentonite	Fatsa, Turkey	recent subsidiary of Italy's Laviosa Chimica Mineraria, the company has opened a new bentonite plant in Fatsa which is currently targeting 50,000 tpa dried granulated bentonite to initially supply cat litter, paper and detergents markets. The company also plans to produce milled grades for foundries in the future.
Northern Graphite Corp. (formerly Industrial Minerals Canada Inc.)	graphite	Bissett Creek, Ontario, Canada	Northern Graphite owns a deposit of flake graphite in Ontario, initially explored in 1989 but postponed when graphite prices fell. Results from pre-feasibility study conducted by SGS Canada expected in Q3 2010. Recently raised $1.45m. through a private placement.
Oregon Resources	chromite, high-Fe ilmenite, zircon	Coos Bay, Oregon, USA	developing five heavy mineral sands deposits in Oregon which contain foundry grades of chromite, high-iron ilmenite, and zircon, in addition to garnet suitable for water jet cutting applications. Mine will be operated similarly to a sand and gravel operation, producing an average of 925,000 tpa for the first eight years, and an average of 770,000 tpa for the 12 years after that. Chromite sand to be principal product, accounting for 64% of products by volume. *See p.45 for an interview with parent company Industrial Minerals Corp.*

> Organic [binding] systems have been developed to perform so well, with such great economics and productivity, that no company is willing to forego that [entirely] to go to an inorganic system that's inherently less productive and more expensive"
>
> **Keith McLean, CEO, HA International**

producers in China. Also the weak euro combined with rising freight costs makes graphite sold in Europe more expensive."

Exchange rates between the US dollar and the euro may prove to have a negative impact on graphite. Technografit GmbH's Dominik Georg Luh told **IM**: "In the short run there are reasonable order books, but long-term forecasts might be difficult as we are not sure about the impact of the current USD/EUR exchange rate situation and the increased raw material prices."

Bentonite

Both calcium and sodium bentonites are used in foundry applications, with Na bentonite typically used in more demanding, higher temperature applications. Bentonite is used to bind together green sand grains used in core mouldings, with around a fifth of bentonite produced used in this application.

Like other foundry minerals bentonite was affected by reduced demand in 2009, although its use in this sector was fairly robust compared to demand from its other end markets in oil and gas drilling and iron ore pelletizing.

Angelo Brodetto, from Italian bentonite producer Laviosa Chimica Mineraria SpA, told **IM**: "The main world [castings] producers – such as China, India, and Brazil – maintained or slightly increased their volumes. [Meanwhile] during the last year European foundry markets reduced their production by 30-35%."

Bentonite prices in the USA fell last year but the trend in 2010 has been firming prices; although these have largely been from increasing production costs including mining, labour and packaging.

The onus appears to be on western bentonite producers to provide reliable foundry mineral supply at prices that are competitive to those offered by producers in developing countries.

"Consumers look to suppliers to provide higher technological products at reasonable prices," Brodetto explained. "Suppliers have to adapt their offers to this demand: offering value-added products and reviewing their cost structures to compete with offers from emerging countries."

New processes

In the last 40 years around 70% of foundry capacity in developed countries has closed, with new capacity migrating to Asian countries and developing markets. This movement in capacity has been driven primarily by production costs, environmental concerns, and the introduction of environmental, waste and energy taxation by Western governments – all of which have combined to make foundries in developed countries uncompetitive.

To counter this trend, within the past few years there has been a drive by foundries in developed countries to focus on reclamation and reducing emissions: "From an environment compliance standpoint, a major development has been the elimination of aromatic hydrocarbon solvents in polyurethane systems, which are widely used in high production environments," HAI's McLean told **IM**.

One such inorganic sand-binding system is Inotec, developed through a joint venture with Ashland Inc. and German bentonite producer Süd-Chemie AG, which is claimed to be emission-free. Inotec has been developed for automotive casting production in collaboration with BMW Group's light metal casting house in Landshut, Germany.

"The real thrust longer term is for wholly inorganic systems that use no organics at all," McLean commented. "These systems are out there, but the issue is that organic systems have been developed to perform so well, with such great economics and productivity, that no company is willing to forego that – and in most cases can't afford to forego that – to go to an inorganic system that's inherently less productive and more expensive."

As McLean explained, the cost difference between organic systems and hybrid/inorganic systems is largely controlled by the price of oil. Over the past five years, the average premium a company encountered when moving to use a biodiesel has been 10-15%. This is coupled with productivity loss and the inability to reuse much of the sand.

"Captive automotive production is the place where you'll likely see an adoption of this kind of [inorganic] technology," McLean told **IM**. "But the capital required to go to an all-inorganic system is large, and it depends on the company involved: *doing the right thing* is a form of value to a group like BMW."

The technology is constantly improving, however, and good headway has been made to improve the productivity of inorganic systems; primarily through adapting the core machinery used to shape sands.

But the fact remains: until environmental legislation improves or the manufacturing community can better the performance of inorganic systems, there will be very few of them operating in the global foundries sector.

Foundry future

Global foundry markets were badly affected last year, although some countries suffered more than others. Industry sources estimate that the North American castings sector reduced by 40-50% last year compared to traditional levels.

"Fortunately North American foundries have rebounded fairly dramatically," McLean revealed. "Surprisingly the rebound comes from the strength of automotive casting. Carmakers are now manufacturing at the same rate as they're selling, so you don't have these huge swings in inventories."

The European castings market has started to recover, although it is understood that raw material shortages combined with shifting old inventories are hampering this somewhat. The good news for European foundries comes from the product development area, where it is thought that German automakers are reassessing iron blocks and moving away from aluminium for smaller engines, which have higher compression that is handled better by iron.

These blocks are more sophisticated and their production – if it increases – will have good implications for more technical minerals such as chromite and zircon.

In Europe and North America foundries have benefitted from the fast growing market for wind turbine blades. Particularly in the USA the wind turbine market has developed over the past five years, from a market that was almost nothing to a very promising growth area.

"The wind power generation market has been cutting a real boon over the last few years," McLean commented. "It's a lot of yield and these are huge castings."

In countries where industrial development is booming – Brazil, China and India – the expectation for the future is growth. The only uncertainty regarding these regions is how much the growth will be.

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