Chromite Emerges as New-Age Molding Material

A one-of-a-kind foundry sand aims to take advantage of geology — and burgeoning demand for steel castings

SpheriChrome is the brand name for an exceptionally round-grained chromite, available from only one deposit source, in coastal Oregon.

An unusual geological development millions of years ago may be about to pay off handsomely for today's quality-conscious metalcasters. Steel foundries in particular are likely to benefit from a new zircon substitute branded as SpheriChrome, mined by Industrial Minerals Corp. (www.industrialmineralscorp.com.au) at its Southern Oregon Mineral Sands Project at Coos Bay, OR, and available in North America through HA International (www.ha-international.com). SpheriChrome is chromite that's unlike any other such sand available, according to IMC, because of the natural roundness of its grains and the narrow particle size.

Those two factors mean the sand is ideal for producing molds and cores that bond better with lower binder content, according to Dan Smith, the chief operating officer at the Oregon operation. That makes HAI an unusual choice as the exclusive, North American distributor for SpheriChrome because binder chemicals are among its primary offerings.

At the same time, the two partners have "a complimentary skill set" for delivering this product to the metalcasting industry, HAI marketing director Lorena O'Neill explained: IMC found it could offer a potentially valuable new product to North American foundries, and needed a partner that had the expertise and access to make that happen. "We operate as partners in trying to reach the marketplace," she said.

More to the point, O'Neill emphasized that HAI's approach to its customers is premised on "total cost of operations."

"We are committed to making the overall operation better, whether it be in cost, or a better casting, or coming up with a (better) solution," she said.

Most foundries would agree that reducing binder consumption would improve their operations, cutting consumable costs and reducing emissions. That's a principle advantage to SpheriChrome's roundness. But, as HAI's foundry sands product manager Mitch Patterson explained, chromite sand is a high-refractory product, with a higher melting point than silica sand that makes it especially suited to high-temperature steel casting. In that way, SpheriChrome offers an effective, more affordable alternative to zircon sand — one of the products for which IMC and HAI aim to offer an option.

Chromite also provides very good heat transfer, allowing a skin to form easily on the surface of the casting to reduce penetration. "It also provides better grain-to-grain contact," Patterson said of SpheriChrome, "so, especially with the conductivity of the chromite there is better heat transfer with that round grain, combined with the chemical makeup of the chromite."

The roundness of SpheriChrome, however, appears to be specific to its source: no other source seems to offer the same grain roundness that is so central to the new chromite's value proposition. It's also a "cleaner" product: less clay, fewer impurities, and easier to handle because of its particular geometry.

Taking shape

That geometry is the result of geology, and specifically to a site about 100 miles south of Oregon's Klamath Mountains. As Smith described it, the chromite minerals began eroding out of the mountains millions of years ago and began to be carried to the Pacific Ocean by numerous streams only to work their way via the long-shore currents back to the cape at Coos Bay, which caused the heavier mineral grains to settle below the lighter beach sand.

"What's unique about the Oregon coast is the high-energy waves," Smith pointed out, "so we get really good segregation between light minerals and heavy minerals … The deposits are formed on the beaches, and they get uplifted because we have a subduction zone about 25 miles offshore, going under the North American plate

which makes the North American plate 'pop up' and these beaches are preserved that way."

The heavy mineral deposits have been prospected for at least 150 years, he recounted, first for gold and later for chromite. As the prospectors worked their way upstream from the beaches they discovered a "mother lode" of chromite settled on "paleo-beaches" that had been uplifted. These are the sites that IMC is mining.

"We've got about three terraces that we are looking at," Smith related. "You can actually see the terrace or the beachfront, the sea cliff, and atop the sea cliff are these deposits – about a mile or a mile-and-a-half inland."

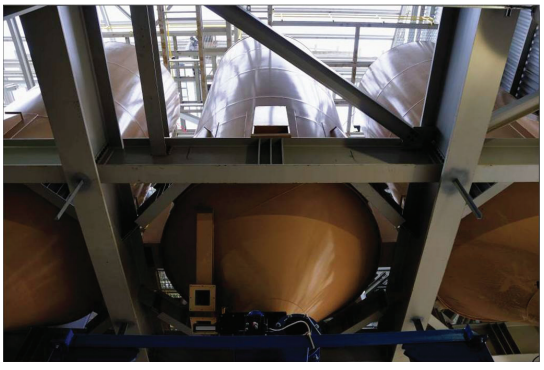
The minerals they gather require virtually no treatment. "It's a great product to sell just as it's coming out of the ground," according to O'Neill. It is neither crushed nor sieved, though there is some sieving and separating to concentrate the mineral qualities collected there.

Processing is done at Coos Bay about 20 miles from the mine site, for logistical and environmental reasons, Smith explained. Fines are gravitationally separated using water, allowing IMC to collect a heavy mineral concentrate that is heated to about 250° and subjected to an electrostatic circuit. This separates minerals into two streams according to their conductive properties, which are then separated according to their magnetic properties. The poorly conductive, highly magnetic material is chromite. Other outputs are garnet, zircon, and silicates. All the minerals are classified according to their physical properties.

"There is no chemical, there is no reprocessing, there is no alteration to the grains that we do whatsoever," Smith emphasized.

Still in progress

IMC has been developing the project in its current format since 2005. It had expected to reach full process capacity of 90,000 tons/year this year, though it did not start commercial operation until late summer and Smith now indicates that output target may not be reached until additional electrostatic separating equipment is installed, in February he indicated.



Industrial Minerals Corp. started processing SpheriChrome late in August, and aims to supply up to 90,000 tons/year of the chromite product.

Meanwhile, performance testing has confirmed all of the expectations for SpheriChrome. Smith noted the material performed differently than the South African chromite that is available now to foundries because of its exceptional roundness. The South African chromite has a much more angular grain structure, due to crushing, he stated.

"We did initial testing and started mixing zircon with our chromite, and then South African chromite with our chromite in different ratios, to see how they would perform. Would ours be a value-added?" Smith recalled. "And, we realized that ours would not be a replacement for South African chromite; it's a value-added (product, compared) to South African. So, we started playing with ratios, and then we started looking at how this chromite performs against zircon and asking, "Could it be a complete replacement for zircon in some applications? And the testing that's going on right now has proved that."

IMC's marketing manager Brianna Hanson said SpheriChrome's advantages over the South African chromite include not only its roundness but also its lower clay content, and she predicted the supply would be more consistent from the Oregon coast.

HAI's Patterson confirmed that South African chromite and zircon are the two main specialty sand alternatives to SpheriChrome, explaining that it offers the chemical properties of chromite and the physical properties of zircon. "So it falls in between, and we're actually finding that we're able to replace both of them in applications," he said.

The timing of this product introduction is supported by the sustained demand for steel castings, particularly those high-temperature steel products with large-section thicknesses. Those products in particular require specialty sands that reduce veining and metal penetration, and provide "chill" to the casting.

While silica sand remains the dominant molding material for steel foundries, SpheriChrome is expected to find success for those areas of the mold where surface or material qualities are most critical. From the marketer's point of view, the variety of steel castings and the increasing volumes that steel foundries are recording should establish a very wide base of opportunities.

"We also have some demand in the larger-section iron markets," Patterson pointed out, "where silica will not hold up, and also a couple of nonferrous applications where the high dimensional stability of SpheriChrome is necessary for high-precision aluminum applications." Brass foundries that must manage chilling defects and eliminate veining may also find SpheriChrome effective he offered.

Patterson also observed that there are potential uses of the chromite in steel industry processes, like refractory nozzles.

For its part, IMC is working to increase its chromite output to respond to building demand for steel castings in North America, Europe, and Asia. As it proceeds with testing and certification for various foundries, it's also working to achieve a preferred status in the supply chain some unnamed European OEMs, explained IMC's Hanson. And, it's eyeing other "product streams" from its Coos Bay operation, such as specialty steel additives that may be developed from the "high iron" concentrates, or low-carbon ferrochromes, and aluminum silicates to be used as blasting media. All of these would be developed from what are now waste streams of the SpheriChrome production process.