CONSARC

An Inductotherm Group Company

Electromagnetic Cold Crucible

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EMCC — History

EMCC (ElectroMagnetic Cold Crucible) is a process of melting metals in a segmented water-cooled copper crucible while under vacuum or controlled atmosphere using an induction coil to heat the melt.

In 1985, Consarc entered into an agreement with the company that patented the ElectroMagnetic Cold Crucible (EMCC) technology for reactive metals to be the exclusive worldwide licensee to promote the EMCC Technology. Since that time Consarc has continuously strived to improve, develop and refine the EMCC Technology to increase its efficiency. Consarc has pioneered new manufacturing techniques for EMCC crucibles, and as a result have increased the crucible life by orders of magnitude. Our early collaboration with the patent holder and relationship with Inductotherm Group helped us develop power supplies specifically suited for the EMCC process and positions us as the most experienced resource for ElectroMagnetic Cold Crucible equipment. The original patent holder alone has claimed to have cast more than 3000 different alloys.

NREL, the National Renewable Energy Laboratory, in Golden, Colorado, first applied the EMCC process to semi-continuous silicon ingot casting in 1985. Although the EMCC process has not caught on in the US, it has been developed by private corporations in Japan and Europe.

In 2009, Consarc embarked on a multi-million dollar project to develop the next generation of commercially available EMCC furnaces. Consarc's EMCC furnace will incorporate our 25+ years of EMCC technology for reactive metals "Know How" to EMCC casting of multicrystalline silicon ingots. The new commercially available EMCC furnace will include many patent pending technologies that will increase the production rate of the furnace while increasing the quality and efficiency of the multicrystalline silicon ingot.

The EMCC process of casting multicrystalline ingots has benefits over that of traditional directional solidification casting processes. The EMCC process utilizes less energy during the casting process compared to the traditional solidification casting process. The purity level of the silicon ingot in the EMCC process is extremely high due to the "container less" casting of the silicon in the water cooled copper crucible. The water cooled copper crucible is reusable, thus eliminating the need to constantly supply costly consumable quartz solar crucibles. The EMCC process has a higher throughput and thus lower production cost in producing multicrystalline silicon ingots compared to that of the traditional directional solidification casting process.

Consarc's standard EMCC production furnace will produce a 3,000 Kg, 510 mm x 510 mm x 5000 mm long multicrystalline silicon ingot in approximately 72 hours; a current state of the art traditional directional solidification casting furnace will typically cast a 625 kg ingot in the same cycle time.

Consarc will also offer a modified version of our EMCC furnace to customers interested in refining solar grade silicon. Consarc's EMR (ElectroMagnetic Refining) furnace will offer semi-continuous zone refining of silicon at an even higher production rate than that observed in our EMCC furnace.

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Electromagnetic Cold Crucible (EMCC)

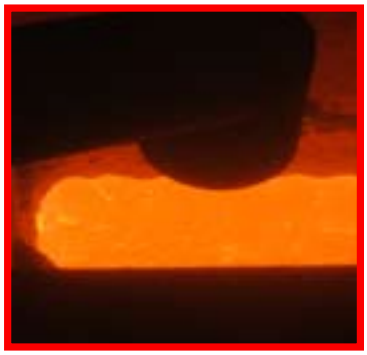
Control Screens for EMCC Furnace

Consarc, an Inductotherm Group Company, has developed new Electromagnetic Cold Crucible (EMCC) furnace technology for producing multicrystalline silicon ingots at a fraction of the cost of traditional Directional Solidification (DS) furnaces.

Electromagnetic Cold Crucible (EMCC) is an innovative process utilizing a segmented water-cooled copper crucible for refractory-free induction melting while under vacuum or controlled atmosphere. Melting in a water-cooled copper crucible eliminates the possibility of contamination from the fused silica solar crucible.

The copper crucible is made up of water-cooled segments or "fingers." The magnetic field produced by the coil, in effect, passes through the crucible to induce heat into the silicon. The magnetic field also intensely stirs the liquid pool and promotes a very homogeneous melt.

Since 1985, Consarc has continuously strived to improve, develop and refine the EMCC Technology to increase its efficiency. We developed correlations between materials melted and power levels, frequencies and crucible diameters. Consarc has pioneered new manufacturing techniques for EMCC crucibles, and as a result has increased crucible life by orders of magnitude.



Molten Silicon in EMCC Crucible

Silicon Ingot

Advantages:

NON-CONSUMABLE/NON-CONTAMINATION CRUCIBLE DESIGN

Consarc's water-cooled segmented copper crucible is designed for multiple heats compared to the one time use of a fused silica solar crucible in a traditional DS furnace. Another major advantage of the EMCC furnace is that the silicon melt is levitated off the water-cooled walls of the crucible, thus avoiding contamination of the molten silicon.

INCREASE PRODUCTION RATE

Typical growth rate of silicon ingots in a traditional DS furnace is 10-20 mm/hr. The EMCC growth rate is greater than 70 mm/hr depending on the withdrawal speed. Another advantage of the EMCC furnace is the increased useable yield from the silicon ingot compared to the average yield achieved in a traditional DS furnace.

PROCESS SAVINGS

Reduced Capital Cost

The EMCC furnace will displace a number of traditional DS furnaces; savings will be achieved with a reduction in factory space and high equipment consumption.

Reduced Operational Cost

- Less man power requirements
- Shorter cycle times
- Crucible is reusable

For more information visit www.consarc.com.

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