

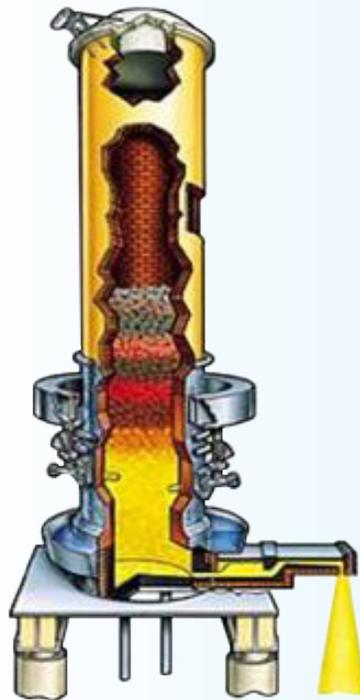


Improving Productivity in Cupola Iron Foundries

In the cupola, oxygen can be an effective yet simple operating tool without high installation costs. The improvement in thermal efficiency resulting from oxygen often allows foundries to meet any or all of the objectives of production increase, raw material savings, and improved cupola control for higher quality output.

Considerable productivity and quality improvement can come with oxygen enrichment; even greater results can be achieved using Linde's proprietary Supersonic Direct Injection (SSDI) or a combination of direct oxygen injection and oxygen enrichment processes. Linde invented SSDI and is on the leading edge in the development of oxygen enrichment processes.

Conventional Cupola Showing Major Parts



With Oxygen Enrichment:

- Increased temperatures
- Increased production
- Lower material costs
- Higher iron/coke ratios
- Hotter iron at startup
- Reduction of rejects
- Improved iron chemistry

With Direct Oxygen Injection:

- Average hourly production rate increases of up to 15 percent
- Improved metal-to-coke ratio of more than 15 percent
- Reduced specific oxygen consumption of up to 10 percent

Oxygen Enrichment in Cupolas

Oxygen enrichment to cupola blast air is a very simple, cost effective solution in which oxygen is combined with air blown in through the cupola tuyeres. Flow control equipment is simple and flexible with oxygen added to the blast air through spargers placed in the main blast air line. Important features of the enrichment system are simplicity, relatively low cost, and low maintenance. Blast air oxygen enrichment often achieves improved metallurgical results, including increased throughput, higher quality product, and the ability to use lower grade source materials.

Direct Oxygen Direct Injection Boosting

Cupola Productivity In the SSDI process, specially designed nozzles blast pure oxygen into the cupola's coke bed at Mach II velocities. By forcing oxygen into the combustion zone at twice the speed of sound, the system pushes the combustion front towards the center of the cupola, resulting in more efficient use of energy resources.

Direct Oxygen Direct Injection Boosting (Con't)

Linde's SSDI process makes combustion more uniform throughout the melting zone, as attested by the relative coolness of the cupola walls. Rather than allow heat to concentrate near the walls, the system rams it further into the cupola to achieve more efficient combustion.

The process can be tailored to emphasize increased production, higher melting temperature, or a reduction of coke, and requires minimal capital expenditure. For example, at one customer location, conversion from conventional subsonic direct injection to the supersonic process improved the coke ratio nearly 10 percent. The net effect was a savings of \$1 per ton in melting costs.

Converting from Enrichment to Direct Injection

If you presently have an oxygen enrichment system, conversion to Linde's SSDI process is a relatively simple and inexpensive procedure that offers substantial operational benefits, including increased productivity, improved metal-to-coke ratio, and reduced specific oxygen consumption. Additional typical benefits can include less refractory repair time in a lined cupola, lower pigging losses, and improved metal chemistry through better sulfur control. Refractory repair benefits are realized because direct injection alters the refractory pattern from an elliptical or irregular pattern—often found when oxygen enrichment is used—to a circular pattern that is repaired more quickly and easily. Shorter repair times can also mean that hot metal will be immediately available when the casting crew arrives on the job.

Direct injection has also been found to reduce the amount of pigging required. While standard practice frequently calls for the pigging of the first ladle, the consistently high metal temperatures achieved by direct injection virtually eliminate the need for any pigging.

Experimentation has shown that with direct oxygen injection into the cupola, less downstream desulfurizing is required to meet chemistry requirements.

For more information about laminar barrier inerting or other metal production applications, call Linde at [1-844-44-LINDE](tel:1-844-44-LINDE), or visit our website at www.lindeus.com