

Gas supply in steelmaking process



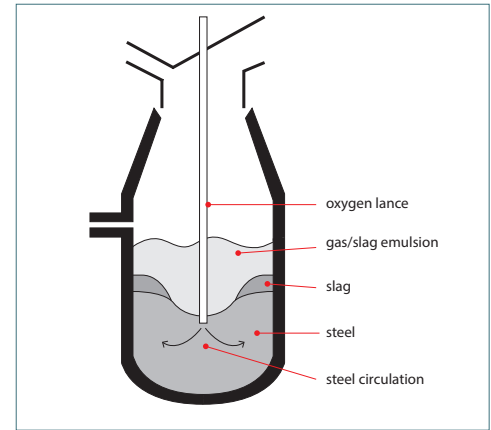
Application note A051-CM04-0716A



In steelmaking, blast furnaces convert iron ore into crude iron by the reducing action of carbon at high temperatures. This crude iron or 'pig iron' still contains a lot of carbon and other impurities that need to be removed, partially or totally, by a reaction with oxygen.

In the basic process pure oxygen is blown from above into the pig iron bath at a certain location using a water-cooled lance. It is important to keep the pig iron melt agitated, for a homogeneous reaction between the blown-in oxygen and carbon from the melt. Inert gases as nitrogen and argon are blown into the melt at the bottom of the converter in which the basic oxygen steelmaking process takes place, to get a well-agitated melt. Especially argon is an expensive gas. As a process dependent control of the gas is important, a company involved in manufacturing of special equipment for the steel industry requested the help of Bronkhorst.

◆ Iron and steel production



Basic oxygen steelmaking process inside a converter

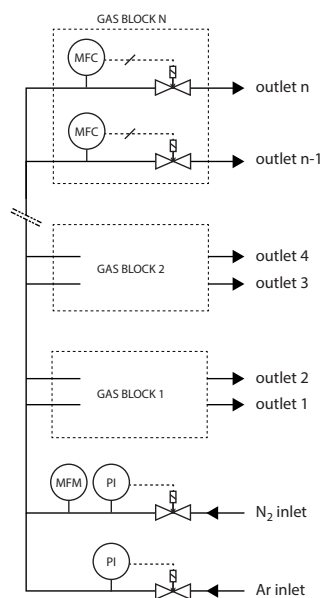
Application requirements

The iron melt has to be in movement continuously, so there has to be sufficient supply of argon. On the other hand, as argon is expensive, the supply has to be limited and well-controlled. Furthermore, as the pressure in the converter is varying, the gas supply control equipment has to be able to compensate for that.

Important topics

- ◆ Accurate control of argon gas supply
- ◆ Compensating for varying back pressure

Process solution

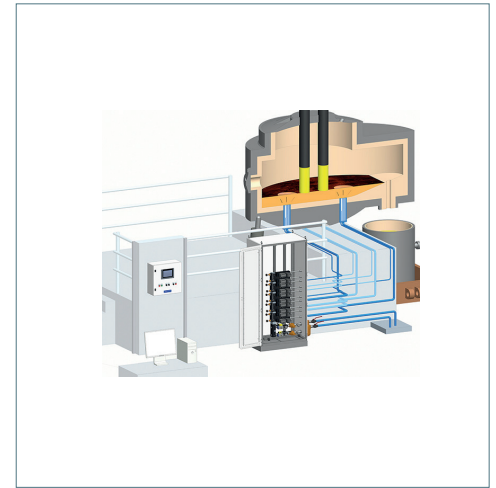


Flow scheme

The inert gas supply system of the customer consists of two gas supply lines, one for argon and one for nitrogen. Bronkhorst delivered the thermal mass flow controllers and their valves; the control unit, the enclosure, the gas lines and the shut-off valves are arranged by the customer. For an optimum agitation of the iron melt, there is a considerable number of inlets in the converter bottom where the inert gas can enter, via porous or gas-channel-containing stone bricks. Each inert gas supply system usually contains between 6 and 14 mass flow controllers. During testing, PID settings were optimised for this process to handle the varying back-pressure in the converter, and to stop the system from oscillating.

Due to extreme process requirements, system pressures of more than 16 bars at maximum flows of 1600 liters per minute have to be dealt with. Only a few manufacturers can fulfil these requirements, and that's why Bronkhorst has been chosen as supplier. Furthermore, compactness of the mass flow controllers was an advantage as there was not much space for the inert gas supply system. If had been chosen for gas supply control equipment of other manufacturers, then a further modification of the system would be required, which would have made the solution much more expensive.

According to the customer, the system works perfect. The process is very stable, and the requirements with respect to cost reduction by accurately dosing the necessary amount of argon have been met. Furthermore, the solution results in less CO₂ emission due to optimised homogenisation of the iron melt, compared to the situation before this gas supply system was installed. Moreover, the customer is satisfied with Bronkhorst with respect to the customer service. At the moment, the customer is setting up a second system. ■



Recommended Products



EL-FLOW SELECT

EL-FLOW Select Series Mass Flow Meters/Controllers are thermal mass flow meters of modular construction with a 'laboratory style' pc-board housing. Control valves can either be integrally or separately mounted, to measure and control gas flows from lowest range 0,014...0,7 mln/min up to highest range 8...1670 ln/min.

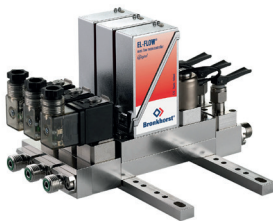
- ◆ High accuracy (standard 0,5% Rd plus 0,1% FS)
- ◆ Rangeability in digital mode up to 1:187,5
- ◆ Fast response (down to 500 msec), excellent repeatability
- ◆ Optional Multi-Gas / Multi-Range functionality: freely programmable ranges and gas types
- ◆ Pressure ratings 64 / 100 bar (Multi-Gas / Multi-Range functionality up to 10 bar)
- ◆ Compact, modular construction



IN-FLOW

IN-FLOW Select Series Mass Flow Meters/Controllers are thermal, bypass-type, mass flow meters of modular construction with a 'industrial style' pc-board housing. Control valves can either be integrally or separately mounted, to measure and control gas flows from lowest range 0,014 ... 0,7 mln/min up to highest range 8 ... 1670 ln/min.

- ◆ High accuracy (standard 0,5% of Rd plus 0,1% of FS)
- ◆ Rangeability in digital mode up to 187,5 : 1
- ◆ Optional Multi-Gas / Multi-Range functionality: freely programmable ranges and gas types
- ◆ Pressure rating 64 / 100 bar (Multi-Gas / Multi-Range functionality)
- ◆ Rugged, weatherproof housing
- ◆ Analog or digital communication (RS232 or fieldbus interface)



FLOW-SMS

On a compact, lightweight but still rugged mounting rail system one or more mass flow or pressure sensor modules can be combined with any functional module as per customer's request. The ranges for the flow sensor can be selected between approx. 5 mln/min up to 50 ln/min or even higher. In case a pressure sensor is included, the pressure range can be chosen between 0-100 mbar and 0-10 bar absolute or gauge.

- ◆ Compact assembly ensures space efficiency
- ◆ Economical solution, low cost of ownership
- ◆ Tubeless construction reduces potential leak points
- ◆ Service friendly; easily accessible from the top
- ◆ Great flexibility regarding system extension or modification
- ◆ Pre-tested "Plug and Play" units, reducing custom testing requirements

Contact information



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CM: Chemical, Metal and Glass
04: Iron, Steel & Metal Industry

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