HIsmelt Process

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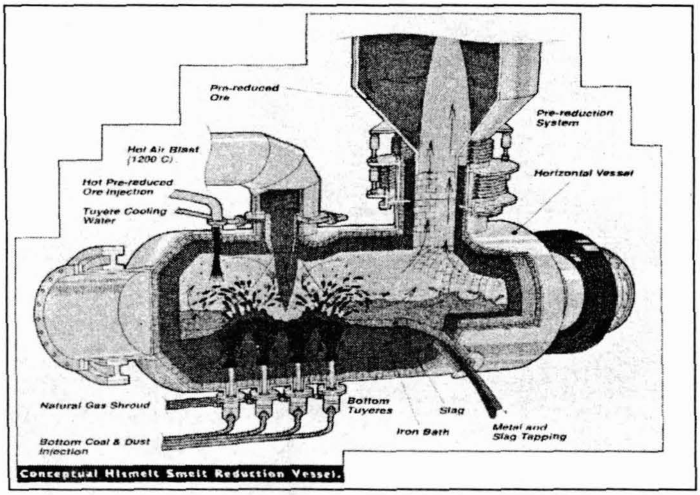
1. GENERAL

HIsmelt is a process in which iron ore fines and/or other ferrous materials and non-coking coal are directly injected in the bath to produce liquid iron (hot metal) of high quality. The process can be considered both as a potential replacement for blast furnaces, as well as a new unit for production of low cost metallic for the mini steel plant based on electric furnaces.

The HIsmelt pilot unit started with a horizontal vessel as shown below, which had a good metallurgical performance, but which was too complex from the engineering standpoint.

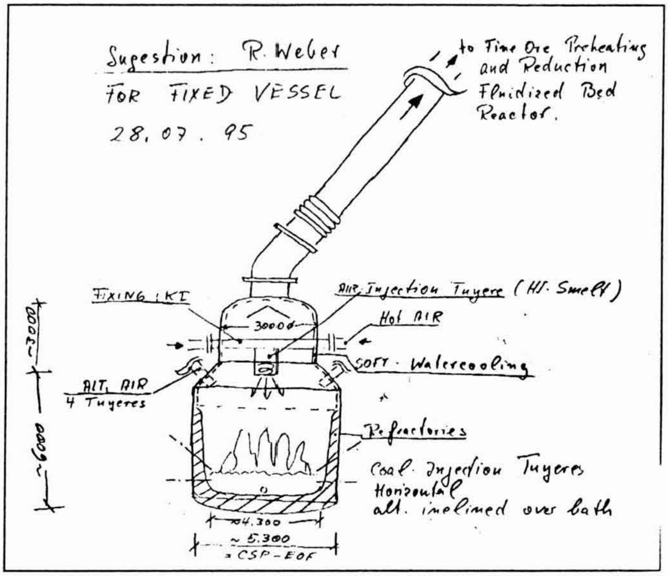


Original HIsmelt Horizontal Vessel

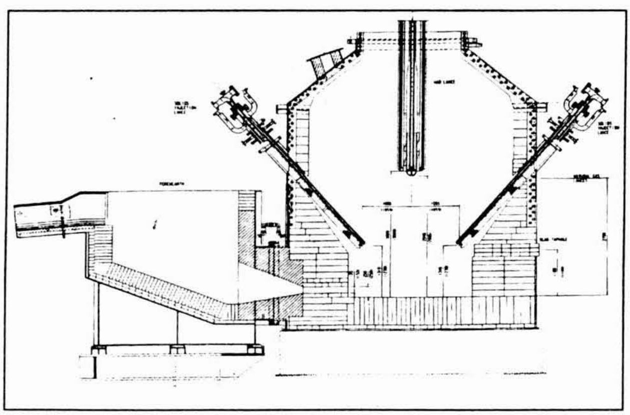
During years 1995 and 1996 bigger developments in the technology were tested and a new fixed vertical water-cooled vessel was set up, which was designed by **ISCON S.A.**

This was the key improvement that allowed the attractive metallurgic properties of the process to be fully utilized.

The basis for HIsmelt process is the reaction of the liquid bath with the coal and the reduction and fusion of metallic particles in the bath, and not on the slag (as it is with other processes under development). The ferrous material and the coal (< 6mm) as well as the slag forming agents, are injected by means of water cooled injection lances, directly in the bath. This allows very high reactions speeds, especially in the reduction of iron oxide, and generates a great turbulence in the bath. The injected coal is dissolved in the metal bath and promotes the reduction of iron oxide. That causes the evolution of carbon monoxide (CO) and hydrogen (H_2) in the bath, which is released by the dissolution of the coal volatiles.



First Drafts by Eng. Ralph Weber of the new vertical vessel.



The new vertical smelting vessel designed by ISCON S.A.

Pre heated air at 1200°C, which can be enriched with oxygen (it was tested until approximately 30%), is injected by means of a water-cooled lance above the bath making the bath CO and H2 post-combustion possible. This releases considerable amounts of energy, which is utilized in the fusion and reduction of the ore. It has been checked that the process's turbulent nature allows an effective transference of energy from the atmosphere to the liquid bath, which enhances very much the efficiency of the process.

The produced hot metal is continuously tapped by means of the forehearth system, similar to the ones that are employed in the Brazilian mini-blast furnaces.

Basically the design and the operational simplicity have decided for the success of the HIsmelt vertical vessel: a stationary vessel with continuous hot metal flow, with coal, ore and fluxes injection system by means of removable water cooled lances, installed on the side walls, water cooled panels on the post-combustion area and slag zone.

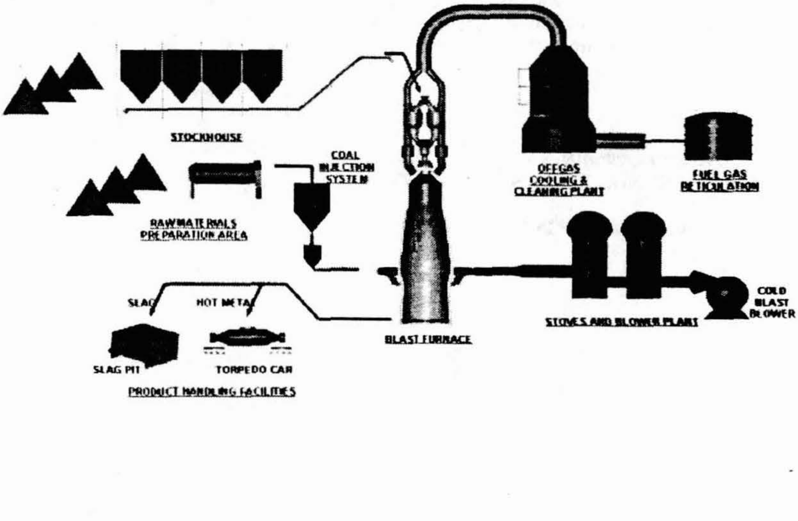
The final outcome of this is that HIsmelt got a plant that was too large for a pilot plant. In fact, the plant in Australia is a plant in an almost commercial scale, and produces between 200 and 450 tons of hot metal every day, depending on the coal and the metallic charge (iron ore, pre-reduced iron ore, or metallic reverts).

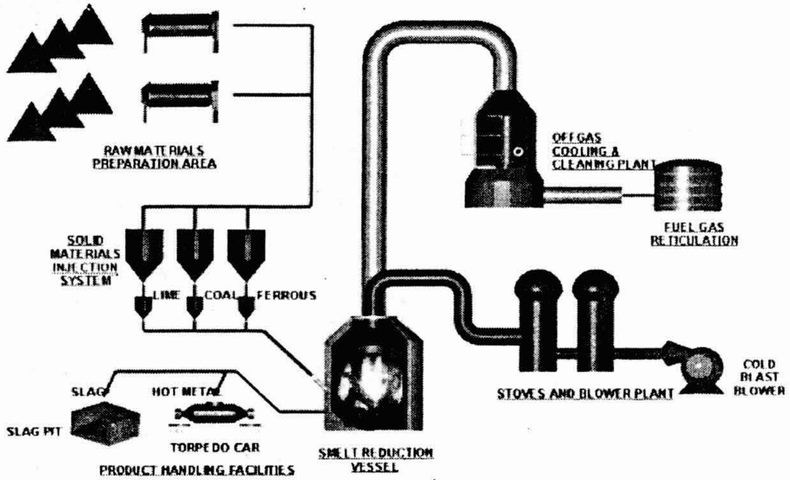
The longest campaign was around 850 hours of continuous operation with availability bigger than 99%. No failure in the reactor critical components took place (including all the water cooled elements) after more than 3,000 hours of operation.

2. Process Evolution

The Australian unit has a hearth diameter of 2.7 m and a production capacity of 100,000 tons/year. The industrial units are being designed for a production of 500,000 tons/year with a diameter of 6 m or 1,000,000 tons/year with the 8-m diameter vessel.

The main advantage for steelmakers is that the HIsmelt process eliminates the demand of coking, sintering or pelletizing, thus reducing the investment cost.
The process can be installed at existing integrated plants with minimum changes as it can be seen below, comparing the basic lay-out of a blast furnace with the HIsmelt process's ones.





As it can be checked, the most part of the process components is proven and the process 'scale-up' technological risks are small. Only the vertical vessel can be deemed as a technological risk, however as a function of the tests carried out and the outcomes obtained, no difficulty is expected with the increase in the size of the process to an industrial scale.

3. Conclusions

The HIsmelt process nowadays has reached such a metallurgical and engineering maturity level that the steel making market in general is seriously analyzing it.
The conclusion gotten from several feasibility studies is that the HIsmelt process is definitely ready to be marketed.
The pilot unit has shown great flexibility as for the use of raw materials. The process can operate with several ores, pre-reduced ones and plant slags.
Steel makers in the United States and Australia are finishing the detail engineering, and soon units of 6 and 8 m. of diameter will be installed.

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