# PULVERIZED COAL INJECTION
## OPTIMIZING BLAST FURNACE OPERATION

DANIELI CORUS

# Pulverized Coal Injection

Pulverized Coal Injection (PCI) was the earliest known form of injection into the tuyeres of a Blast Furnace, but it was not until the early sixties of the last century that PCI has been implemented successfully for hot metal production. Trials in several countries at this time had proved that the technology for pneumatic transport and injection of coal was available, but the relative ease and economics of the process were such that oil and natural gas became more popular injectants. AK Steel in the USA and Shougang in China were the exceptions, where PCI was used more than forty–five years ago and is still practiced today.

Auxiliary fuel injection, therefore, has been practiced for a number of years by iron makers to reduce the consumption of coke in the Blast Furnace and to increase Furnace productivity and stability of operation. The cost of coke is very high when compared to that of tuyere injectants and replacing the use of coke with alternatives has the following additional benefits:

→ Coke purchased from external sources could be minimized or eliminated altogether for plants with a coke shortage. The cost of building a new coke plant is about three times more than that for a PCI plant, for example. Even a rebuild of an existing coke plant can be twice as expensive when compared to the cost of a new PCI plant

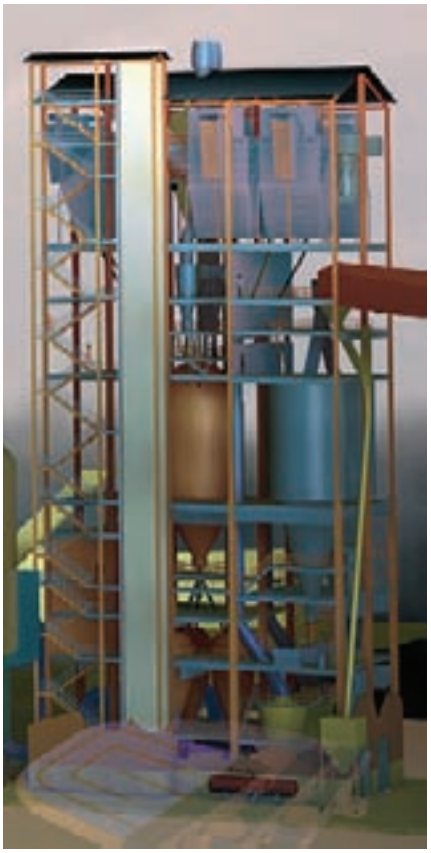
→ The useful lifespan of existing coke batteries could be prolonged by running the batteries at reduced throughput, thereby obviating the need for costly rebuilds

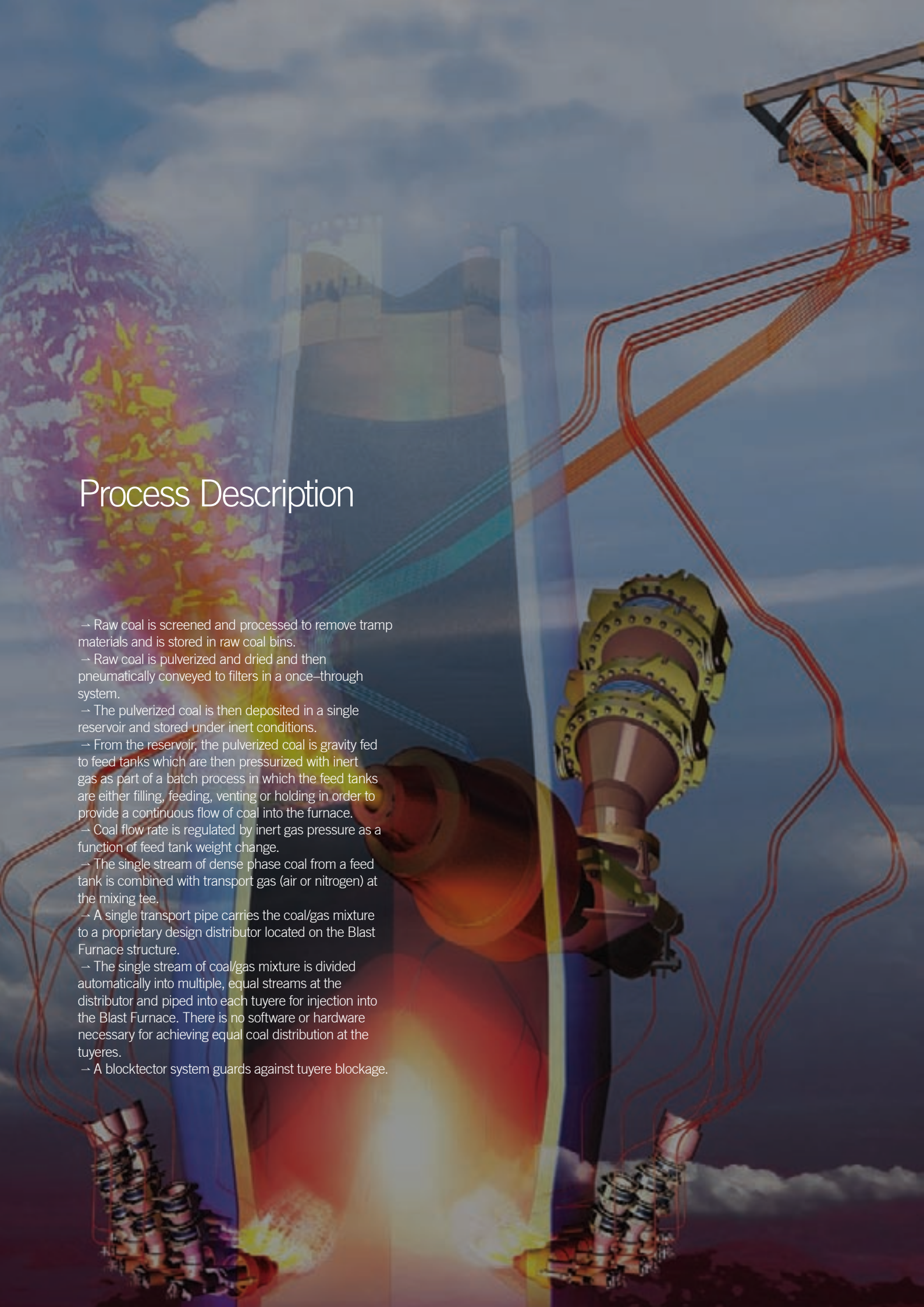
→ Old, environmentally unsound coke plants could be shut down

→ Reducing the output of an existing coke battery could improve the quality of the coke produced by using the extra process room created due to the lower production rates

Within the boundaries posed by process parameters such as flame temperature and pressure differential over the burden, tuyere injectants also benefit the Blast Furnace process enormously. The cooling effect of the injectants in the raceway enables the use of higher hot blast temperatures and lower moisture additions, thereby reducing the total fuel consumption. The same cooling effect also permits the use of a higher concentration of oxygen in the hot blast, thus reducing the raceway gas volume and hence Blast Furnace pressure drop, thereby significantly increasing productivity. The use of injectants, along with the correct control strategy, can improve Blast Furnace stability and hot metal quality through improved thermal control.

Due to ease of use, oil, followed by natural gas, were the popular injectants in the sixties and seventies. With the oil crises, many companies stopped injecting oil into the Blast Furnaces and turned to alternative sources of fuel. Coal preparation and pneumatic conveying had become proven technologies by that time and this encouraged iron makers to consider coal as a suitable injectant. Most iron makers inject coal into their Blast Furnaces at present, the vast majority since 1980, due to its relatively low cost and beneficial effects on the Blast Furnace process.

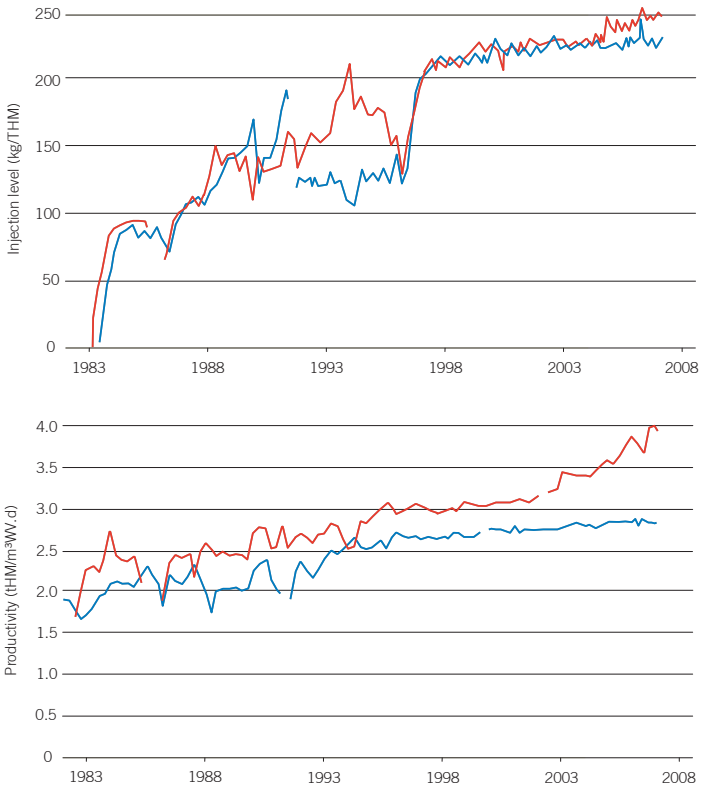




# Process Description

→ Raw coal is screened and processed to remove tramp materials and is stored in raw coal bins.
→ Raw coal is pulverized and dried and then pneumatically conveyed to filters in a once–through system.
→ The pulverized coal is then deposited in a single reservoir and stored under inert conditions.
→ From the reservoir, the pulverized coal is gravity fed to feed tanks which are then pressurized with inert gas as part of a batch process in which the feed tanks are either filling, feeding, venting or holding in order to provide a continuous flow of coal into the furnace.
→ Coal flow rate is regulated by inert gas pressure as a function of feed tank weight change.
→ The single stream of dense phase coal from a feed tank is combined with transport gas (air or nitrogen) at the mixing tee.
→ A single transport pipe carries the coal/gas mixture to a proprietary design distributor located on the Blast Furnace structure.
→ The single stream of coal/gas mixture is divided automatically into multiple, equal streams at the distributor and piped into each tuyere for injection into the Blast Furnace. There is no software or hardware necessary for achieving equal coal distribution at the tuyeres.
→ A blocktector system guards against tuyere blockage.

Pulverized Coal Injection is an essential tool for the improvement of Blast Furnace Process parameters and Furnace profitability. These figures show the increase of the coal injection rates at the Corus IJmuiden Blast Furnaces over the years (top) and simultaneous improvement of productivity (bottom). The red lines are data for Blast Furnace No. 6 and the blue lines for Blast Furnace No. 7.



# Advantages of the Danieli Corus PCI system

→ Lowest capital and operating cost system available.
→ Coal pulverizing and drying utilizes long–proven technology.
→ Total weight of injected coal is controlled by a load cell system, which adjusts continuously to meet the set–point.
→ Simple and effective coal distribution system. The distributor weighs less than one ton, has no moving parts and may be mounted conveniently on the existing Furnace structure.
→ The distribution system ensures even distribution of the injected coal between the total number of tuyeres and incorporates an inherent capability to redistribute automatically the total coal injected into the Furnace, should injection be discontinued to one or more tuyeres.
→ All equipment for any number of Furnaces (excepting transport pipe, distributor and distributor pipes to tuyeres) is accommodated in a single building sited up to 1600 m from the Blast Furnaces.
→ System permits maximum flexibility at minimum cost for injecting coal into a different Furnace (i.e. when Furnace is shut down).
→ There are no moving or modulating parts in contact with coal in the storage, transport and distribution systems.
→ Proven availability practically 100%. Highest reliability means multiple pulverizing paths.
→ Single design responsibility from receipt or raw coal through injection lances.
→ Coal is dried thoroughly to prevent saltation, compaction, and to lower the moisture penalty on the Furnace.
→ The transport and distribution system is blown clean when injection is stopped.
→ Restart of full injection requires less than one minute.
→ The total system is composed of equipment available from multiple sources. There are no proprietary components to be purchased.
→ Experience gained in commissioning many systems ensures optimum start–up and rapid attainment of high injection rates. This system is used in Blast Furnaces all over the world.
→ Full training (in The Netherlands and at the Client's site) and operational assistance (at the Client's site) is available where required.

Danieli, the Reliable Innovative Team in the Metals Industry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