BLAST FURNACE OPERATIONAL SERVICES SPECIALIZED ASSISTANCE PACKAGES

DANIELI CORUS

Blast Furnace Operational Services

Complementary and additionally to the application of engineering solutions in the ironmaking industry, Danieli Corus has the facility to offer operational solutions in a variety of scenarios. Our knowledge, expertise and experience spans the development and implementation of high levels of PCI, hearth monitoring and repair, casthouse, raw material, and productivity optimization, salamander tapping services, campaign extension, to name but a few.

Assistance can be offered on any basis, ranging from on–call emergency help to a long term assessment and strategic campaign extension study, and covering all items in between. The range of experience that Danieli Corus has access to gives an unrivalled ability to satisfy any customer requirements, whatever, wherever and whenever a problem arises.

Process Optimization

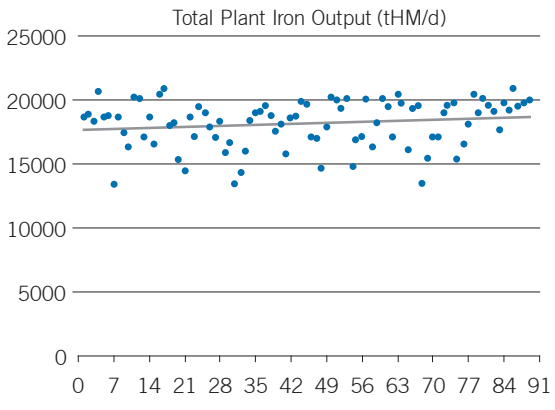
There may be periods when the blast furnace is not operated to its maximum capability, due to reduced demand, or equipment problems for example. After extended periods of non–optimal operation of the blast furnace, turning the process round can be a difficult challenge. This challenge can be met through co–operation between on–site technologists and operators with the assistance of consultants.

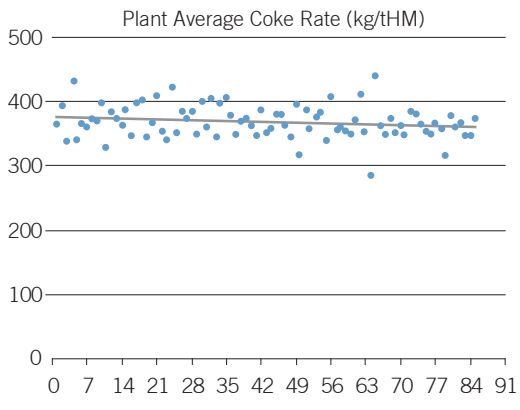
Danieli Corus have fulfilled this role during periods of up to three months continuous assistance, or intermittent visits and data exchange over longer periods of time. In either case the emphasis is on sustainable improvement, so that the return to optimum operations is well understood by all, and the lessons learned become standard operating practice for the future.

The beginning of the assistance can either be a very specific request, such as improving the liquid removal from the furnace, or it can be very general, such as to lower the coke rate. In either case, a brief assessment phase is carried out to obtain an overview of the process, both good and bad aspects. The investigation phase then concentrates on the problem as stated by the client, looking at potential contributory factors and quantifying their relevance.

Dependant on the client's wishes, the assistance can then end with a list of recommendations to be implemented, or it can continue while the recommendations are carried out and feedback is given, with the potential for further improvement through a more regular feedback and review stratagem. Training and education are an integral part of the assistance, with each recommendation backed up by example or data, so that the client is fully integrated into the problem solving team.

Support in this area has recently been given to plants located in India, Slovakia, USA, Mexico and Argentina.



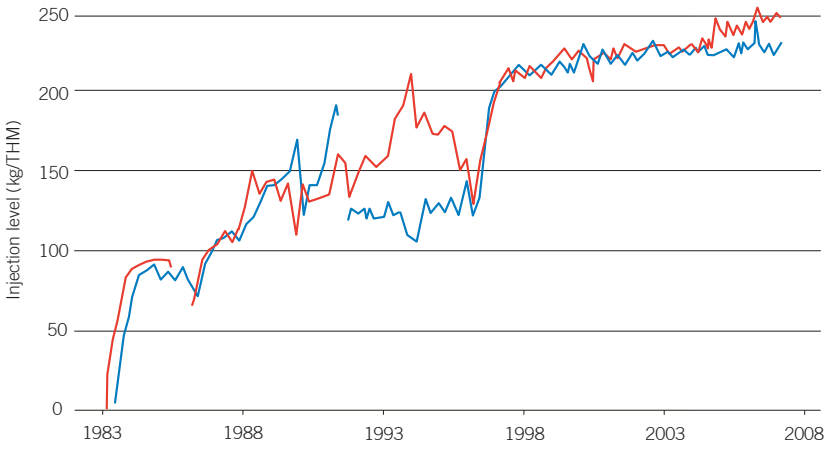


Coal Injection Optimization

With every kg of coal that can be injected, there is an associated coke saving and increase in furnace productivity through higher rates of oxygen enrichment. Or at least that is as it should be. The pursuit of high coal injection rates is in reality the quest for lower coke rates and increased production, and this is more related to the process itself than to the capability of the equipment. Whatever capacity the system is rated to, that should be the goal for normal injection rates. Often this is not the case, with many furnaces playing host to excessive coal injection capacity that often remains unused.

The optimisation of the coal injection system is often a two–fold improvement in both the coal equipment and the blast furnace process. Danieli Corus is uniquely placed with their extensive knowledge in the construction and operation of coal injection installations to carry out such optimisation projects. Danieli Corus has sold over 50 PCI installation and process know–how is based on experiences with the system at Corus IJmuiden, where injection rates of over 250 kg/tHM and productivities of 4.0 tHM/m³WV/d have been achieved. Optimisation projects have been carried out in India, USA, and UK.

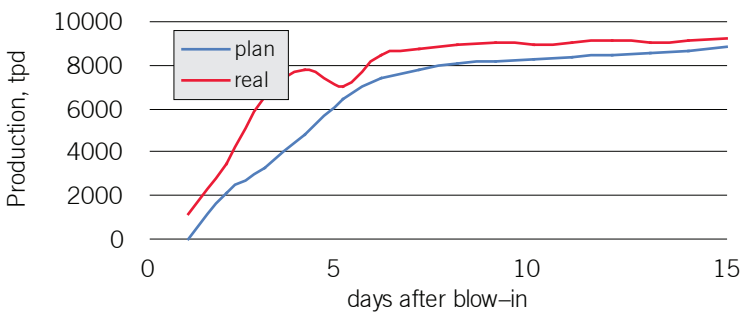
Historic Injection Rates at Corus IJmuiden Blast Furnaces

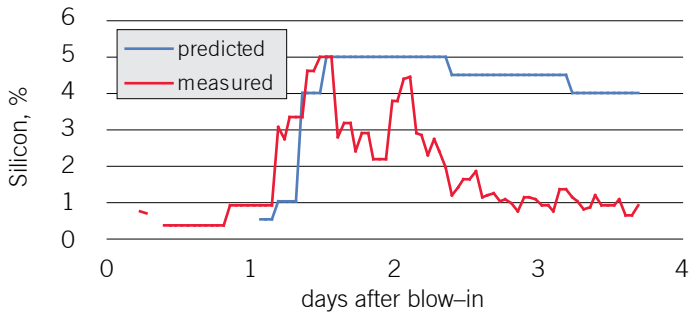


Blast Furnace Blow–ins and Start–ups

Danieli Corus enjoys the ability to call upon experienced blast furnace experts to offer intermittent services such as blow–in and start–ups. Given the long campaign lives, that are now considered normal, these critical phases in blast furnace operation are far from everyday business for younger operators.

Our small, but experienced team has carried out blow–ins of furnaces world–wide for the past twenty–five years, in countries most recently including Brazil, Australia, India, The Netherlands and Italy.

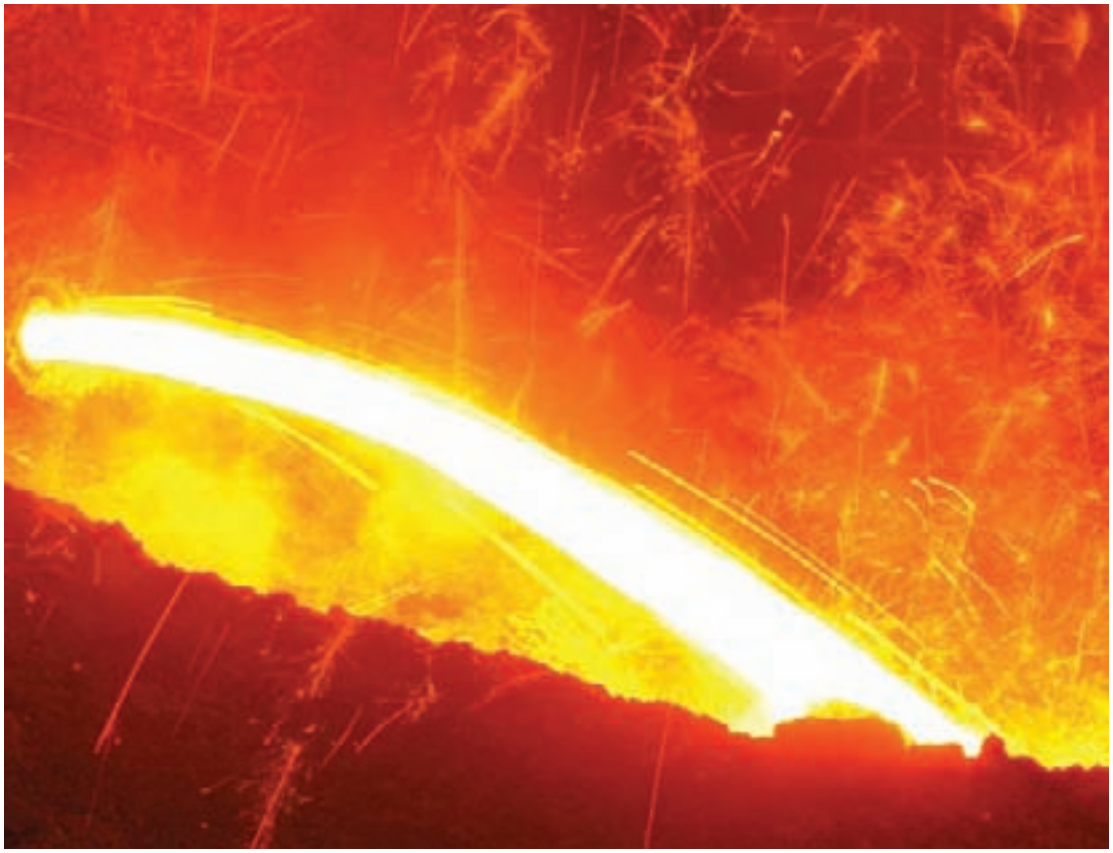




Blast Furnace Chill Recovery

Although not an area that one might wish to gain a lot of experience in, the technique applied by Danieli Corus for the recovery of blast furnaces with a chilled hearth has been tried and tested in numerous locations, such as Spain, Chile, Slovakia, USA, Brazil, Australia, South Africa, South Korea, Turkey and India. Danieli–Corus has developed special “oxyfuel lance technology”, which is used in about half of the recoveries. The measures differ depending on the extent of the chill, and early notification is always recommended for the quickest recovery. Our lances system, based on our proprietary oxy–fuel technology, is always on stand–by for delivery and can be on–site within 48 hours worldwide.

No two recoveries are the same, but our team of experienced operators have proved able to adapt to any situation, providing advice at all stages of the recovery to ensure a rapid and stable return to normal operations.



Emergency Assistance

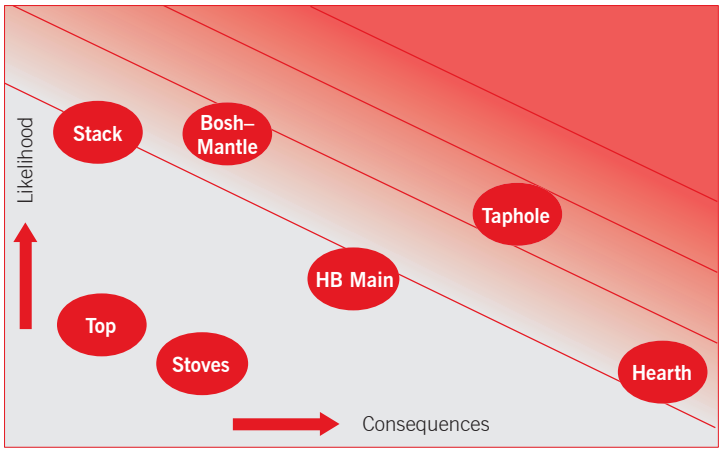
In the event of unforeseen problems that require immediate operational or engineering support, Danieli Corus is stood by ready to dispatch assistance at very short notice, sometimes even within 24 hours. Plants that have required and received such support in the recent past have been situated as far afield as Australia, Slovakia, Italy, Chile, Spain, Brazil, India, Canada and South Africa.

Campaign Life Extension

Postponement of a blast furnace reline is a major decision for every integrated steelmaker. Large capital expenditure and loss of production must be balanced against the risks of sudden failures if the furnace life is extended. Campaign extension technologies are available for repairing the most critical areas in short stops, and, if emergency repair plans are in place, then it becomes possible to increase campaign life, or even adopt a "zero reline" philosophy within manageable risks.

Lengthening the campaign of the furnace almost endlessly is an obvious way to avoid spending a large amount of money and suffer production losses. However the flip side to this is the increased risk of equipment failure or sudden unplanned termination of the campaign. An audit can identify these risks and quantify the likelihood of occurrence and potential consequences. Monitoring capability also plays a large role in assessing the potential for significantly extending the campaign of a furnace, with special attention given to those areas that are particularly vulnerable.

The Hearth Monitoring System (HMS) has been developed for just this reason and is designed to present the hearth thermocouple information in such a way that it provides a key insight into the prevailing conditions in the hearth. This control room based tool fully integrates the operator into the campaign extension efforts as he can monitor very closely the growth of a hearth skull, or protecting lining, or the potential loss of refractory lining.



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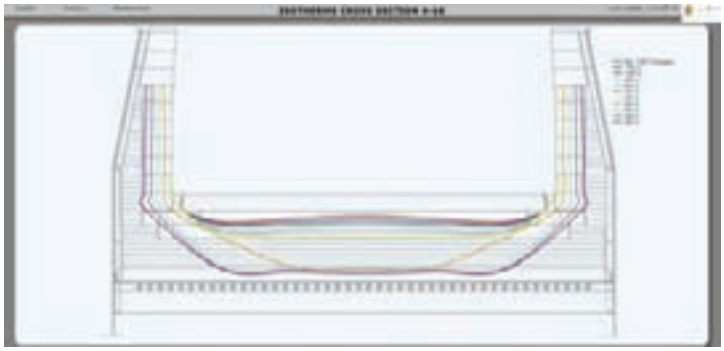

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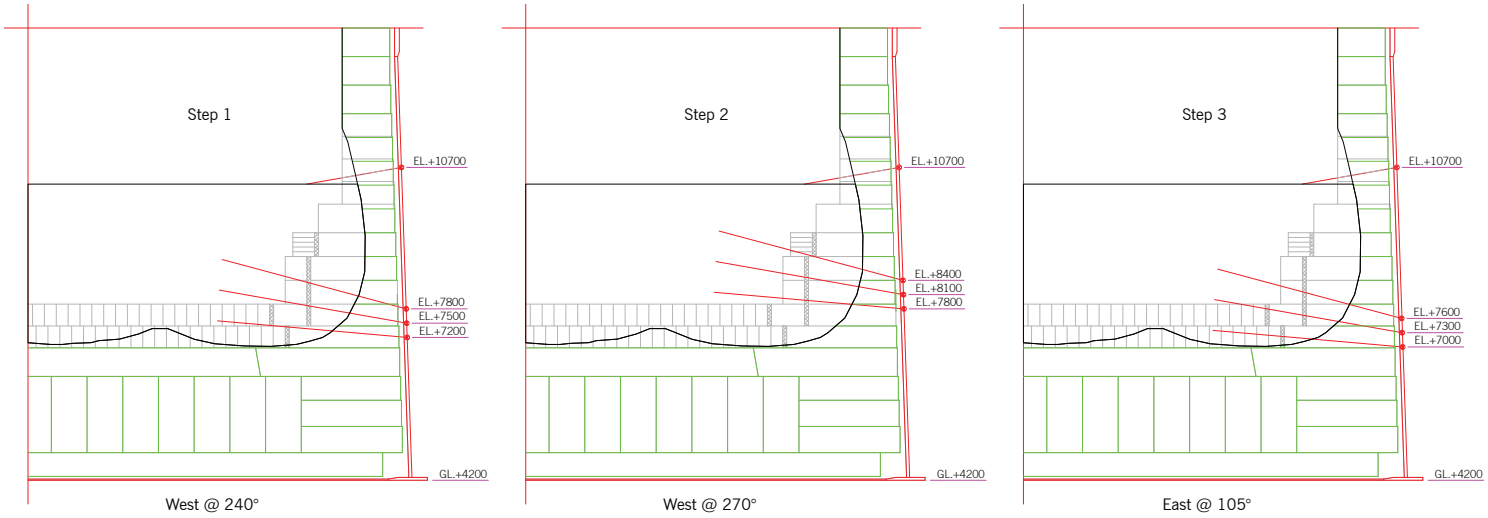
1 Example of Risk Assessment
2 Hearth Monitoring System



Salamander Tapping and Blow–down Services

The salamander includes liquid iron and slag and mixtures of solid iron, slag and coke/carbon. These bottom and hearth constituents must be evacuated when relining the blast furnace and it is also recommended to evacuate the liquid salamander prior to partial relines and taphole repairs. Danieli Corus can provide support in maximising the yield of the liquid salamander, while also advising on the likelihood of having to deal with an already solidified partial salamander during operation of the blast furnace.

Blast furnace preparation and monitoring to increase temperature and fluidity, coupled with use of well tried drilling and lancing techniques are the key items for successful liquid salamander removal. The removal of the salamander before commencing reline or repair work provides safer working conditions and prevents damage to the hearth refractories as a result of cyclic cooling and heating movements.

A large solid salamander, however, is usually difficult to remove, and can delay the critical path of the project by several days or even weeks. Dynamiting and oxygen lancing may often be required causing health and safety hazards, thus it is important to maximise the yield of the liquid salamander tap, which is normally tapped immediately after the blow–down.

Blow–down, salamander tap and quench projects have been carried out in for example South Korea, Slovakia, Argentina and Italy.

Plant Assessment Studies and Cost Improvement

A significant part of the cost of steelmaking will be determined in the primary end: the raw material cost, coke and other energy sources. Efficient use of these materials in the Blast Furnace will have a large impact on the total cost chain. Furthermore a high utilization factor and an increase in productivity will also indirectly improve the bottom line on these costs. Although the basic requirements are the same. in reality major differences exist between blast furnaces.

By carrying out an independent audit, these differences are highlighted, and where improvements can be made, solutions to resolve them are identified.

Why an external auditor?
It is not immediately obvious why an external resource would be used for such task, however the following benefits add credence to the audit, which may not be present internally;

- Independent, non–biased view.
- Short, dedicated, focused effort.
- Guaranteed deadlines.
- Benchmarking against international BF practice.
- In depth experience with inspection and condition monitoring techniques
- Multi–disciplined team encompassing Process Technology, Operations, Maintenance, Repair and Reline engineering options.
- Immediate reporting to entire BF team on site on completion of audit.

On–site Training and International Familiarization

Our on–site training services include operator training programmes as well as courses providing fundamental understanding of the modern blast furnace ironmaking process and blast furnace operation at high rates of pulverized coal injection.

Training programs can either be located at our own site in The Netherlands, or at the client's site. A training program in IJmuiden brings with it the opportunity to witness first–hand the practical application of the classroom based course by visiting the Corus IJmuiden Blast Furnace facilities.

Danieli, the Reliable Innovative Team in the Metals Industry

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