

SECONDARY METALLURGY



INTRODUCTION

Highly productive and efficient steelmaking for all types of steel grades challenge the right set-up of state-of-the-art secondary metallurgy systems. Our customers' process requirements and production targets are the driving forces for SMS Concast in developing, engineering and supplying of tailor made secondary metallurgy facilities.

Analysis of the metallurgical process steps, material flow in the meltshop as well as the requirements for the heat cycle times are the inalienable initial activities to design the appropriate concept.

SMS Concast always combines the raised concept with powerful automation and latest process tools. Together with reliable mechanical design, our engineers create the flexible technical solution for virtually every refining plant.

The main systems of a modern secondary metallurgy facility are:

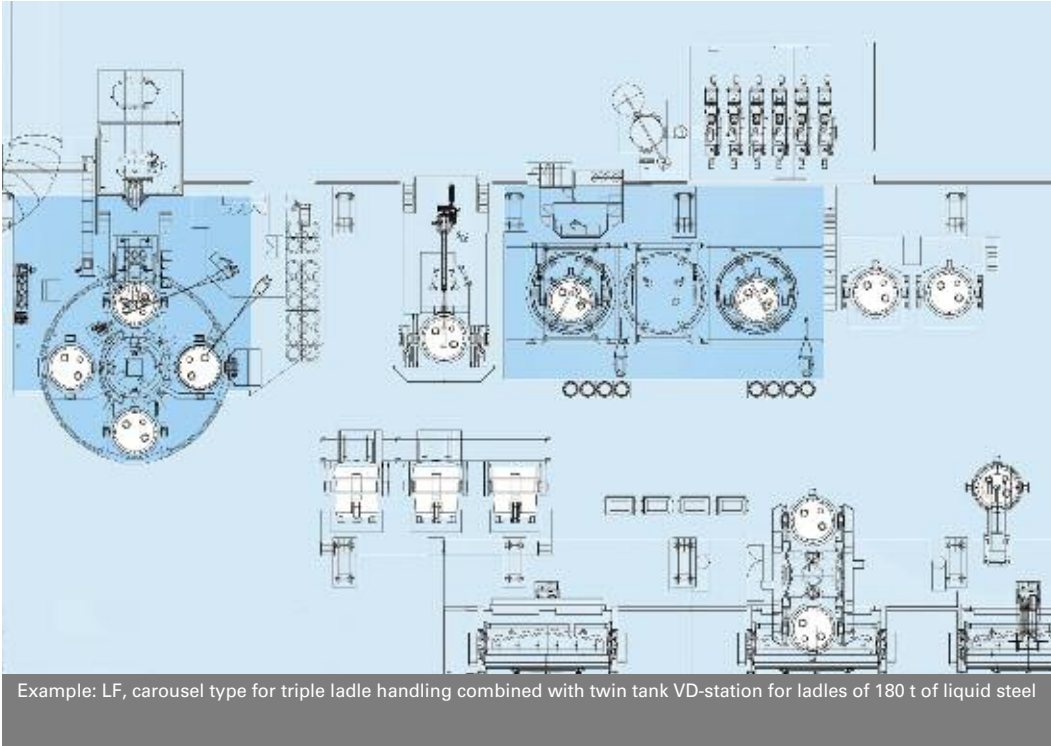
- Ladle Furnace, either as single or twin unit, as well as triple ladle treatment station and
- Vacuum Degassing (VD), or
- Vacuum Oxygen Decarburisation (VOD) station

These ladle treatment systems are completed with different process and safety tools for smooth and efficient operations, such as:

- Automatic sampling and temperature measurement
- (Emergency-) inert gas or oxygen lance
- Camera systems for safe process observation
- Level 1 and Level 2 automation system
- Ladle deslagging station



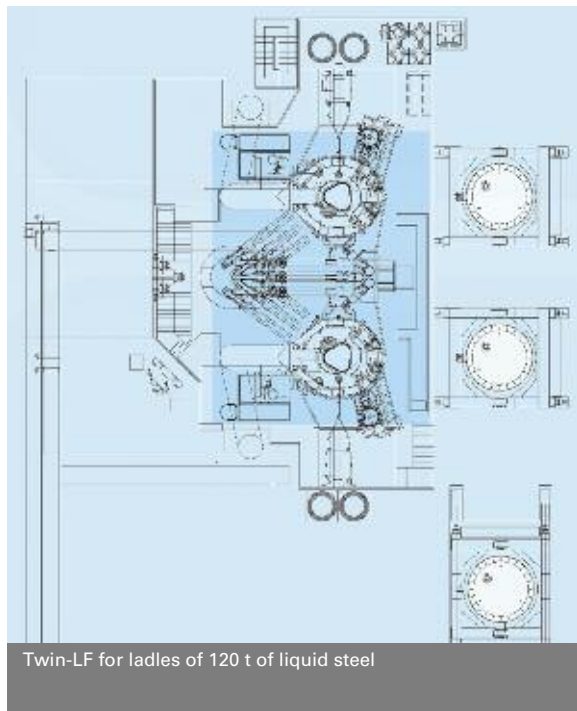
CONCEPT



The best environment for cost efficient, reliable and safe secondary steel treatment is the perfect set-up and composition of the facilities. Therefore the following topics are main issues:

- Optimum plant layout
- Production mix target in quality and quantity
- Cycle times of upstream and downstream processing units
- Current space and material flow data
- Current energy and utilities data

The concepts for secondary metallurgical systems can vary between single Ladle Furnaces for production of low alloyed grades up to twin and triple ladle handling furnaces or even multi LF arrangements for the production of high alloyed grades with long treatment times. All these assemblies can be combined with ladle vacuum treatment stations for VD or VOD processes, also in single, twin or multi tank systems. For both VD and VOD processes, mechanical vacuum pumps lead to highest flexibility with lowest energy consumption compared to steam ejector systems.

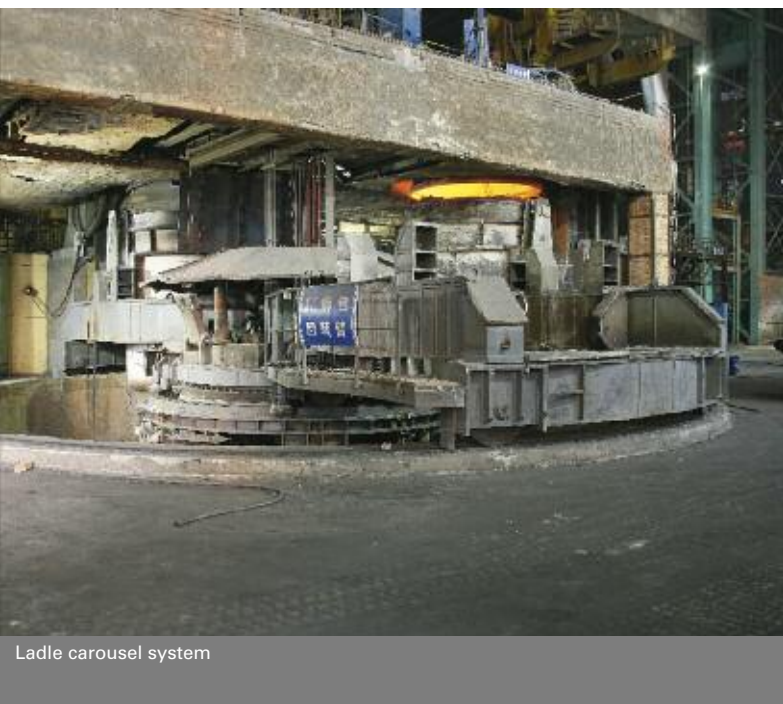


LADLE FURNACE

The process requirements and heat cycle times are considered as the main Ladle Furnace set-up features. SMS Concast provides the appropriate solution, namely single ladle treatment stations, twin LF arrangements up to triple ladle handling by means of a carousel system.

The Ladle Furnace process tools and design features, like minimised draft roof, sampling and temperature manipulator, stirring equipment, wire feeder as well as modern automation systems, lead to highest process and working safety with lowest consumption and emission. Cost optimised performance is guaranteed.

The long reference list of SMS Concast remarkably expresses the substantiated know-how which leads to the highly estimated solutions. The range of steel grades starts with low alloyed and reaches up to high alloyed carbon steels and stainless steel processing lines. Ladle sizes of 20t up to 350t of liquid steel guarantee the right steel composition at the adequate temperature.



Ladle carousel system



VD/VOD

Depending on the produced steel grades and its final product applications vacuum treatment is required. For Vacuum Degassing and for Vacuum Oxygen Decarburisation stations SMS Concast set standards with its installations.

Main features of the ladle vacuum treatment stations are:

- Generation of vacuum either by mechanical or steam ejector pumps
- Vacuum bag filter and heat exchanger in the suction line
- Compact tank design with emergency volume
- Dry, well protected cover sealing
- Water cooled splash shield
- Auxiliaries, like sampling manipulator, wire feeder and oxygen blowing system for VOD

Also in these applications, state of the art automation systems guarantee full process control.

ECONOMY & ENVIRONMENT

New technologies regarding further minimisation of all kind of emissions are the challenge of our R&D specialists to improve or substitute our technologies in the field of steelmaking.

In the range of secondary metallurgy, the implementation of VD/VOD-system with mechanical vacuum pumps for all ladle sizes were successfully performed. These systems feature the following advantages, compared with conventional steam ejector systems:

- Lowest energy consumptions
- Highest flexibility, as a result of vacuum on demand with no lead time
- No cooling water impurity from the process gases



Vacuum tank

VACUUM GENERATION

For many years, steam ejector pumps have been the only aggregate to produce vacuum for the degassing of liquid steel. They produce enough suction capacity at acceptable investment costs, but they have serious disadvantages on the running costs, e.g. high energy consumption for steam production and production of contaminated water/hazardous sludge. Furthermore, steam is not always available in sufficient quantity and flow.

The dry mechanical vacuum pumps, which have been developed and adapted to the specific steel works environment, represent a valuable alternative. Facing the running costs and the issues with the environment the time to change from the 'previous' steam ejector pumps towards the 'modern' mechanical vacuum pumps has come.

The combination of high volume flow roots blowers and screw compressors combined with an efficient off-gas cleaning method represents a high-rendering, economically interesting and ecologically mature solution and substitute for the steam ejector pump solution.



Mechanical pumps

The roots blowers and the screw compressors are manufactured with fine tolerances to achieve a high efficiency and must be protected against dust/slag particles to ensure a long and trouble-free life. To do so, a filter system, consisting of a cyclone and a bag filter, is located upstream of the pump unit. Some of these dust/slag particles exhibit pyrophoric behaviour. Therefore, precautions have to be taken against oxygen entering the filter before the filter bags have been cleaned by use of inert gas. A dust monitoring system is applied and signals any filter malfunction, so that corrective action can be taken long before they become a risk for the vacuum pumps.

AUTOMATION

Ladle Furnace and Vacuum Degassers are fundamental stations to achieve the necessary quality and to avoid delays of the production cycle. To ensure this, the activities between the different process areas need to be synchronised.

The automation and control systems dedicated to LF, VD or VOD ensure the proper control of process parameters with advanced thermodynamic and chemical modeling. The steel temperature and chemical composition are continuously calculated.

Mathematical models, fed with real-time process data gathered by the automation system, estimate the thermal exchanges within the molten steel. They evaluate the changes of the steel temperature during the process considering:

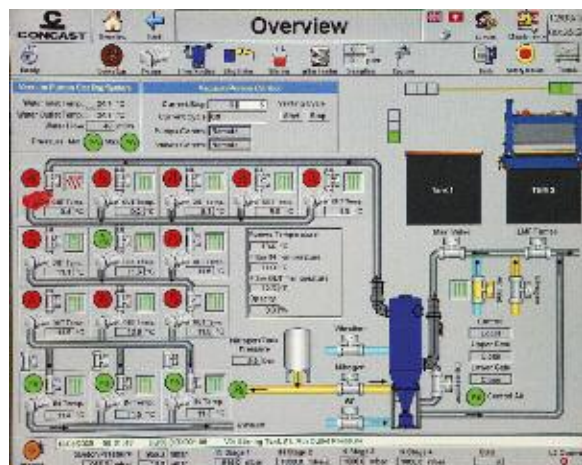
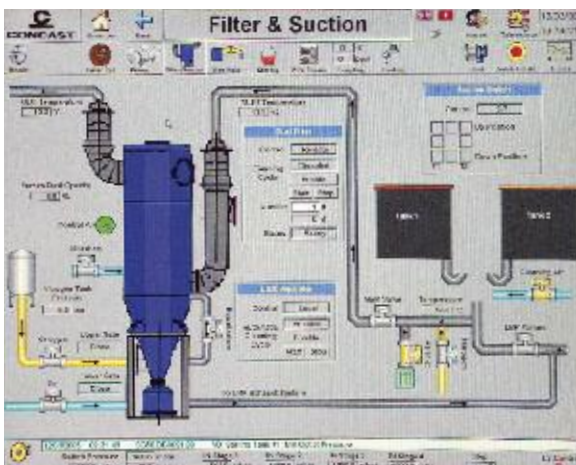
- The heating effects of arcing
- Chemical reactions
- Energy losses due to material additions
- Stirring gas
- Continuous dispersion of heat

Chemical activity models estimate the activity factors and values for each element in the chemistry of both steel and slag, based on their current composition and temperature.

Finally, the least-cost recipe addition model suggests the best recipe of addition materials to achieve the target analysis from the currently estimated steel composition and temperature. While searching for the optimal addition mix, the model does also consider constraints related to relevant analysis formulae defined by the metallurgist.

The technological packages dedicated to secondary metallurgy include:

- Advanced electrodes regulator for Ladle Furnaces
- Heat and mass balance model
- Chemical activity model
- Steel-slag interaction model
- Element fading model for Vacuum Degassers
- Least-cost recipe addition model
- Alloys/wires addition control
- Stirring control
- Process analysis and simulation
- Metallurgical data management
- Production delays detection
- Equipment life tracking



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PASSION for **PROCESS**