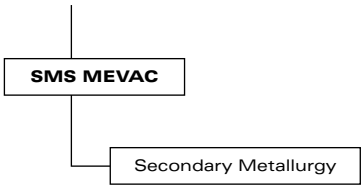
NEW SECONDARY STEEL TREATMENT OPTIONS

implemented at Ternium-Siderar, Argentina



Reprint from
„MPT International“ 02/2014,
pages 50-53

Authors:
Raúl Daniel López, Mariano Aguirre; Ternium-Siderar,
Gral. Savio Plant, San Nicolás, Buenos Aires, Argentina
Thomas Eichert, SMS Mevac GmbH, Essen, Germany

NEW SECONDARY STEEL TREATMENT OPTIONS

implemented at Ternium-Siderar, Argentina

In order to produce locally high-quality steel grades that previously had to be imported, Ternium-Siderar decided to broaden its secondary metallurgy treatment capabilities. A state-of-the-art vacuum steel degassing unit of RH-TOP type, supplied by SMS Mevac, was recently commissioned. The new plant started operation in late 2013. Using the new facilities, low-carbon steels for deep-drawing and interstitial-free (IF) steel grades can be added to the range of produced steels.

Ternium-Siderar is the largest steelmaker in Argentina, producing hot and cold-rolled strip as well as galvanized, painted and tin steel products. More than five thousand people are employed at production sites in Ramallo, San Nicolás, Ensenada, Haedo, Florencio Varela, Canning and Rosario. The integrated iron and steel works, Planta General Savio is situated in San Nicolás. Here, until recently the steel plant consisted mainly of the following equipment:

- a desulphurization station for hot metal,
- three LD converters (basic oxygen furnaces) with the option of combined N_2/Ar bottom blowing (LBE),
- a conventional ladle furnace (35 MVA),
- a ladle treatment station.

New RH-TOP vacuum degassing plant at Ternium-Siderar during construction.

Using this equipment, Ternium-Siderar successfully supplied to the markets a variety of flat steel products, including low-carbon commercial steels, structural steels, grades for piping and micro-alloyed steels – complying with standard quality demands and with a high cleanliness level, i.e. low level of macro-inclusions (which are deposited in grain boundaries in the steel crystal structure).

Within the framework of the 4 million t/year expansion plan, Ternium-Siderar decided to enhance its secondary metallurgy capabilities, venturing into more quality demanding markets (deep-drawing grades, interstitial-free steels, degassed steels, etc). Consequently, a vacuum degassing plant was needed to reach a new level of metallurgical cleanliness. Ternium-Siderar decided to implement an RH-TOP-type plant which recirculates the liquid steel under vacuum while applying supersonic oxygen blowing with a water-cooled lance (TOP unit).

SMS Mevac was selected as the supplier of the new equipment. After implementation and commissioning, operation started in late 2013. This new plant now produces liquid steel feeding the continuous slab caster No. 1 and in future also the new caster No. 2 which is scheduled to start operation by summer 2014. In future, it will be linked to and operate in correlation with a new ladle furnace and a new ladle treatment station.

FINDING THE OPTIMAL VESSEL GEOMETRY

As a preliminary consideration, it was first necessary to study and theoretically compare two alternatives for the design of the vacuum treatment vessel: the conventional cylindrical (round) design or a modified design by copying the actual ladle geometry at Siderar, which would result in an oblong (elliptic) vessel cross section.

A numerical simulation was carried out in order to assess both alternatives, allowing the fluid-dynamic behaviour of the liquid steel inside the ladle to be estimated in advance. For this study, Ternium-Siderar worked with Instituto Argentino de Siderurgia (IAS – Argentine Steelmaking Institute) [1]. The IAS had already developed a numerical fluid-dynamic liquid steel stirring model for the study of the various positions of porous plugs in the bottom of the ladle and regarding

Functional principle of the RH-TOP technology.

the different levels of the stirring flow. Important results were obtained within only two weeks.

The result was that the option of designing a vessel with an unconventional shape, as proposed by Ternium-Siderar (oblong vessel), did not provide any substantial improvements. Although the oblong design provides certain advantages compared to a traditional cylindrical design, i.e. less dead zones, longer vacuum contact of liquid steel inside the vessel and less stirring in the free surface of the ladle, these benefits are outweighed by the disadvantage of very high shear stress in the refractory lining due to the action of the rising steel flow from the snorkel of the RH vessel bouncing back from the ladle bottom. This would result in a considerably reduced life time of the refractory lining and the consequent increase in operative costs.

For this reason, Ternium-Siderar engineers rejected this alternative since it would be an unprecedented prototype instead of the practice-proven round vessel design. Nevertheless, the investigation of the various numerical modelling results provided profound knowledge concerning the fluid flows in an RH unit. This know-how is important for future developments with the unit in operation.

DECISION BETWEEN VESSEL LIFT AND LADLE LIFT

A critical objective was to select equipment that would provide operational flexibility and reliability, while causing as little impact as possible on the existing facilities and the building. A study was conducted regarding the system that would handle the relative movement between the ladle (containing the liquid steel) and the vessel (container where the vacuum treatment occurs), while fitting best the characteristics of the existing building and providing the best safety conditions.

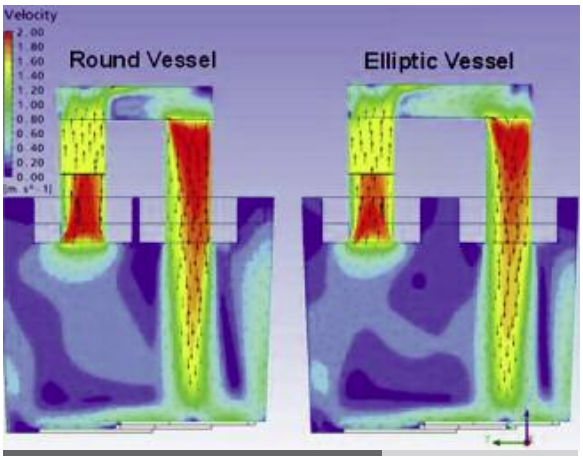
As the new RH plant was to be installed inside the existing steel plant building, the specific layout situation had to be taken into account when it came to deciding which lifting method was to be used. Apart from the operating and process requirements, all aspects related to the maximum allowable lever action on the structures, the components of the existing building and safety aspects had to be taken into account.

Every possible alternative in the RH design was analyzed [2]. A basic decision had to be taken as to whether the steel ladle or the vessel was to be in charge of the lifting and lowering movements relative to the liquid steel column inside the snorkel for the recirculation of the steel between the vacuum vessel and the ladle. For this decision, information was gathered from 60 of the most recent global projects.

From an economic point of view, the most convenient alternative was ladle lifting and lowering, as it would have been advantageous for the existing building and operative layout, in both the present situation and in view of the next planned investment, which considers the installation of a second continuous casting machine. Ternium-Siderar and SMS Mevac discussed how to implement the advantages of the proven safe and reliable "rocker type" vessel lifting system in a ladle lifting system. This implied a simple connection from the vacuum vessel to the vacuum pump system, thus avoiding a complex rotating joint as in case of vessel lifting. Finally, this ladle lifting system known as "ladle rocker" safely prevents the ladle car from interfering with the ladle and the vacuum system during the entire process [3].

Control pulpit during start up of the plant on Sep. 9th, 2013.

This thoroughly studied fact is an innovation compared to other designs in RH facilities. Besides the benefits of operative flexibility and low maintenance effort, Ternium-Siderar guarantees maximum safety for people and facilities in case of liquid steel spilling in the event of a ladle breakout. From the very beginning of the project, both Ternium-Siderar and SMS Mevac engineers weighed highly the additional benefits provided by this solution.



Simulation of speeds in the middle plane for both vessel geometries.

BENEFITS OBTAINED FROM USING THE LADLE ROCKER

Optimal use of the existing building. For implementing the ladle rocker, the only thing necessary was to raise the roof twelve meters up, while keeping all the horizontal structures.

Car operation flexibility. The design of the ladle rocker eliminates all interference between the ladle and the ladle car during vacuum operation. The optimum position of the RH unit between the melting and the casting bay allows using a second ladle transfer car which may move under the ladle while the vacuum treatment is in process. After completion of the treatment, this second car will take the ladle to the take-over position

Lifted ladle while vacuum treatment is in process on Sep. 9th, 2013.

for casting, while the first car has already moved back to the take-over position in the melting bay to receive the next heat.

This is an important aspect under an operational point of view, as it optimizes the manoeuvring times for loading and unloading the ladles filled with liquid steel and does not require any modification to the existing installation. In this way, using one car in the station loading area and a second one in the unloading area increases both flexibility and productivity while reducing the tap-to-tap times.

It is worth emphasizing that adding a second ladle transfer car did not imply any modification to the existing installation. Actually, the future layout providing for the use of two cars will be similar and compatible with the initial version. With a view to a possible upgrade of the plant to operate with higher productivity it was considered that just by adding a second ladle transfer car feeding of two continuous casting machines would be possible.

CONCLUSIONS

From the very beginning, engineers from Ternium-Siderar participated actively in the project to find the optimal technological solution. This started with the study of fluid physics in vacuum treatment by modelling the actual fluid dynamic behaviour using resources available in Argentina.

The employed "ladle rocker" technology represents minimum investment versus alternative current best practices in implementing the relative movement between the vessel and the steel ladle. It provides best safety conditions, minimizing the risks for people and equipment. It also achieves high operative flexibility, both for the current project and for a future expansion project providing the preconditions for feeding a second continuous slab caster.

REFERENCES

[1] Modelización numérica de Vessel del futuro horno RH de Ternium Siderar - Raúl Daniel López - Mariano Aguirre - Sebastián Sylvestre Begnis - Daniel Dalmaso - 17ª Conferencia de Acería / Metalurgia de Cuchara | IAS 2009, Campana, Pcia. Bs. As., Argentina

[2] R. Beermann, R. R. Eggert: Lifting systems for RH-type vacuum degassing plant. MPT International 1/2014, 36 - 46

[3] Ladle Rocker for the new "RH" at Ternium Siderar - Raúl Daniel López - Mariano Aguirre - Dominik Lemken - Rainer Teworte - 18ª Conferencia del Acería / Metalurgia de Cuchara | IAS, 2011, Rosario, Pcia. Santa Fe, Argentina

[4] Nuevo Horno RH-TOP para la fabricación de aceros desgasificados y de muy bajo carbono en Ternium Siderar -Raúl Daniel López - Mariano Aguirre - 3er Congreso Argentino de Ingeniería Mecánica, CAIM 2012 | UTN-FRBA, Buenos Aires, Argentina

[5] Raul D. López et. al.: New RH-TOP at Ternium-Siderar. 19ª Conferencia del Acería / Metalurgia de Cuchara | IAS, 2013, Rosario, Pcia. Santa Fe, Argentina

SMS MEVAC GMBH

Bamlerstrasse 3a
45141 Essen, Germany

Phone: +49 201 6323-0
Telefax: +49 201 6323-200

E-mail: mail@sms-mevac.com
Internet: www.sms-mevac.com

MEETING your **EXPECTATIONS**

H5/222E
500/05/14 · Ky · Printed in Germany