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Reducing reheating furnace gas consumption and the billet head-tail temperature differential for bar mills

Nuova Carpenteria Odolese (NCO) have developed and commissioned an insulated roller table/billet reject table, between the reheating furnace and first stand, to retain heat and reduce head-tail temperature differentials, in new and existing and bar mills

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DESIGN AND BENEFITS

Gerdau Steel awarded the Italian company NCO (Nuova Carpenteria Odolese), an order to study, design, manufacture, supervise the installation of and commission an insulated roller table/billet reject table. The table was to be located between the reheating furnace and the first stand, to retain the heat and reduce the head-tail temperature differential, in the limited available space. The solution also includes a new housing-less vertical roughing stand and its drive train, enabling Gerdau Cambridge to increase its billet size.

The new insulated roller table/reject table and the new roughing stand allowed Gerdau to increase the billet size, and retain heat in the billet tail, even once the tail was out of furnace for over 150 seconds prior to reaching the first stand. This technology not only saves gas consumption, but also enables tail temperatures to remain within allowable limits for proper rolling.

A major technological advantage of this solution was the ability to install the new system in the limited space available between the furnace and the mill. This was achieved by combining the insulated roller table with the billet reject table. This feature allows the system to be applied to most existing plant layouts. A typical configuration of the roller table and rolling stand is shown in *Figure 1*, while *Figure 2* shows the insulated roller table.

The insulated table enables considerable savings on heating energy and a minimization of the billet head-to-tail temperature differential, for better product quality consistency. NCO conducted all process and site engineering for this upgrade, designed the civil works, and designed and manufactured the equipment. All the equipment was designed, manufactured, pre-assembled and tested in NCO's workshops and premises in Italy, allowing for on-site erection without production downtime and installed successfully during an 'optimized short' shut down.

The overall benefits of this solution include its environmental impact, with reduced fuel consumption, ▷

Fig 1 **Insulated roller table and rolling stand typical configuration**

Fig 2 **Insulated roller table**

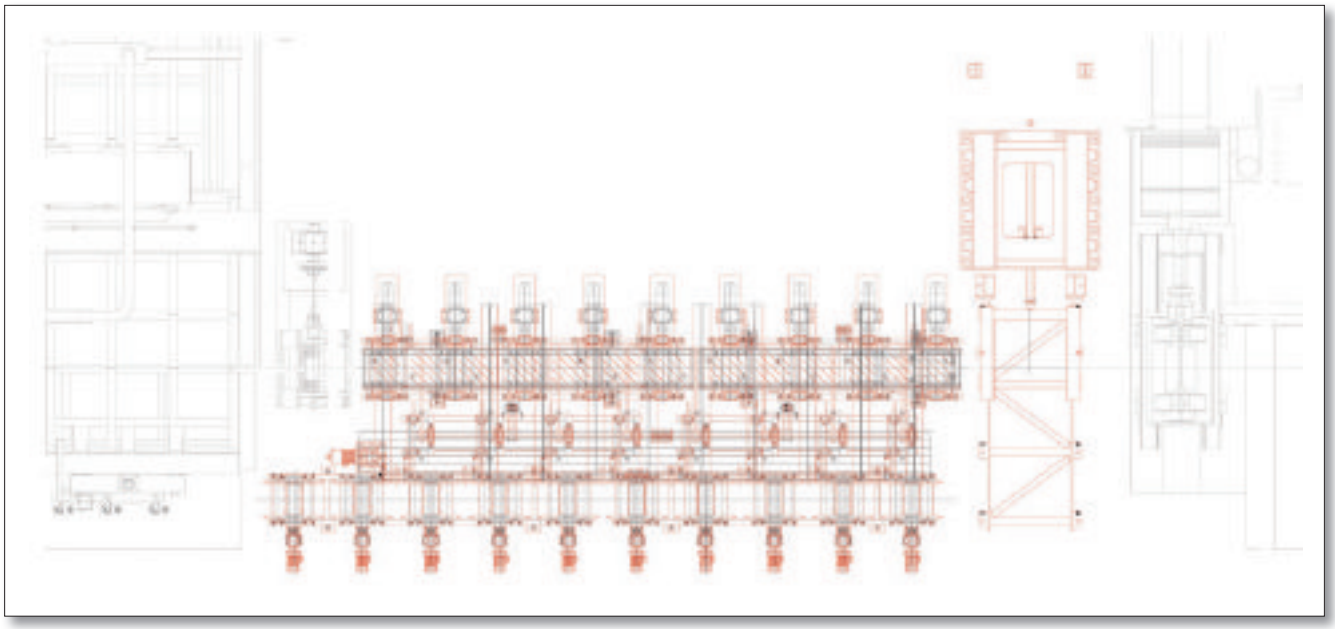
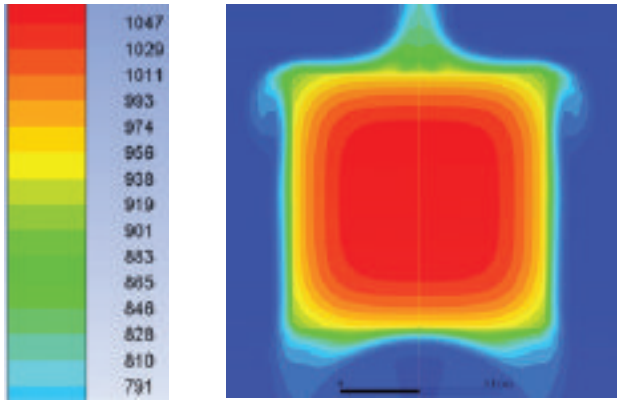


Fig 3 **Top view layout**



Temperature [˚C]
Only for reference

Red = Billet Core Temperature
Yellow/Green = Billet Skin Temperature
Blue = Surrounding Air Temperature

Fig 4 **Billet contour temperature**

more reliable equipment and a positive improvement in plant capacity and product quality. There was no negative impact on the existing process, or general layout, with a top view of the layout shown in *Figure 3*.

INSULATION COVER THERMAL PERFORMANCES: A PRACTICAL RESULT

Thermal calculations and simulations were carried out using dedicated software for Computational Fluid Dynamics (CFD) analysis, to evaluate the temperature loss in the head and tail of the existing billet and the new billet, both with and without the insulating cover. The results were combined with internal knowhow from NCO and fine-tuned with use of the field data from the various previous similar installations made by NCO worldwide. *Figure 4* shows the temperature distribution in the section during cooling.

Simulations were carried out for the new billet size and associated furnace throughput. The different furnace unloading temperatures for the head and the tail of the billet were considered. The rolling time in stand one and the furnace throughput were matched. These theoretical simulations were compared with field data obtained after the installation and start-up, further validating the accuracy of the models, the design and the realization of the entire solution.

Without insulation cover on the furnace run-out table, the head and tail temperature differential of the billet was 40°C. When the insulated cover is used for the same rolling speeds and furnace discharge temperatures, the temperature of the head and tail of the billet at the first stand is increased to generally +20°C and the head-to-tail temperature difference was reduced to about 20°C. *Figure 5* shows the billet temperature trend as a function of time, for the core, skin and weighted average.

The main direct results are a higher billet temperature at the stand and a lower differential temperature between end and tail of the billet. In a practical sense this gives a more homogeneous and higher average temperature across the entire billet. These results indicate that even if the rolling time in the first stand for the larger billet increased by about 38% compared with the current practice, the

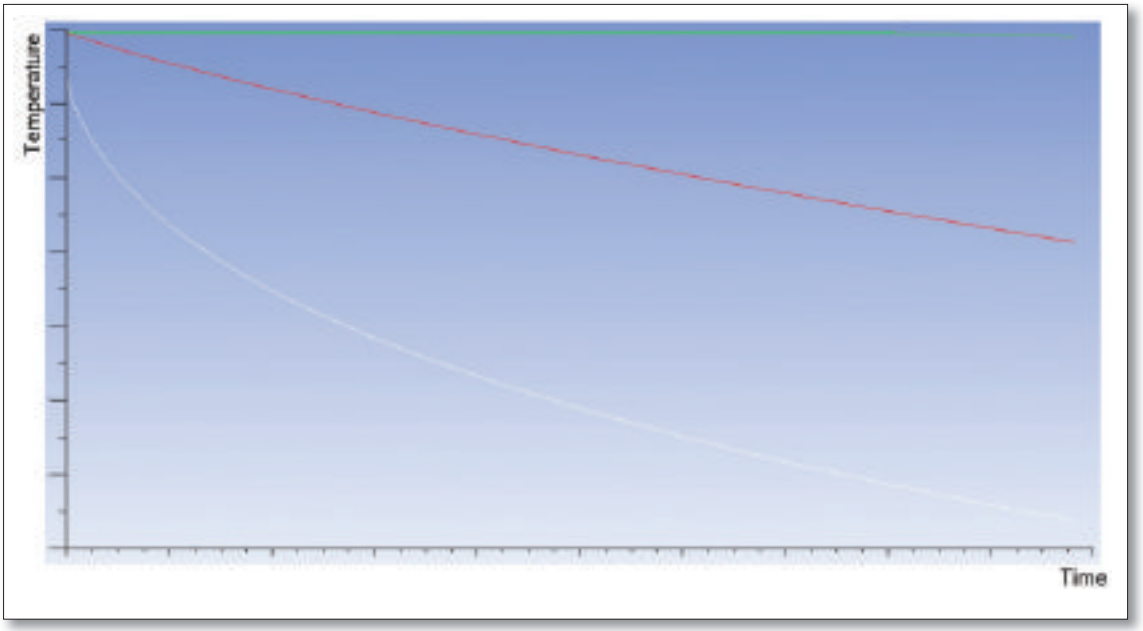


Fig 5 **Billet temperature as a function of time**

differential between the head and the tail was reduced by about 50%. Empirical evidence from similar installations indicates that the use of insulated covers allows the mill to reduce the average furnace exit temperature by 50°C. This results in 10-15% less scale formation and at least 5% lower gas consumption.

CONCLUSIONS

The main advantages of the insulated roller table are:

- Reduced CO_2 production and lower environment impact.
- Reduced energy consumption and therefore OPEX.
- Reduced oxidation of the material.
- Reduced gas consumption at the furnace, and reduced fumes and unburnt products in the chimney.
- Reduced electricity consumption.
- Increased safety for service personnel and operators.
- Flexible solution for future expansion with minimal investment.

A visual comparison of the advantages of this solution, versus traditional operation is shown in *Table 1*.

The success of this project was reliant on NCO's technology capability, but also demonstrated how know-how, reliability and service are of utmost importance to the company. **MS**

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	NCO	Traditional
Quality	+	-
Energy saving	+	-
Green: Low CO_2	Low	High
Oxidation: Low	Low	High
Methane/Gas	Low	High
Electricity: Low consumption	Low	High
Safety	+	-
Sales profit	+	-

Table 1 **Comparison between the NCO solution and a traditional roller table without insulation**