EVOLUTION OF COSIPA'S SINTER PLANT Nº3 PRODUCTIVITY[1]

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Abstract
The purpose of this paper is to shown the evolution of productivity of Cosipa' s nº 3 Sinter Plant (with nominal capacity of 33 t / m^2 / day) since its start up in 1982 until now. It shows the measures to increase this index in the last three years, mainly that realized during the major repair occurred in June 2007. The improvements in the fluxes, in the feeding system and in the exhaustion gas and cooler seal systems are described. The productivity raised to 40 t/m^2/day with these actions. Finally the plan to the next period is described with the implementation of automatizated sub gates, segregation intensified feeder and permeability bars expecting to achieve 43 t/m^2/day .
Key words: Sintering; Productivity; Grain size segregation.

1 *Technical contribution to the 3rd International Meeting on Ironmaking, September 22 – 26, 2008, São Luís City – Maranhão State – Brazil*
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1 INTRODUCTION

On the actual pig iron production rate at Cosipa, the sintering plants are more and more demanded.

A lot of actions have been made, mainly in these last three years, aiming to raise the sintering productivity and the sinter availability to the blast furnaces.

This paper shows such actions, divide them in phases:

At the first one, in 2005 2nd semester, improvements in limestone size distribution and in the lime reactivity were made. In this phase was reached an improvement in the raw mix permeability.

At the second phase, developed in 2006, were normalized the feeding system equipment and after the adjusts realized, a certain grade of segregation in the bed was obtained which resulted in an increase of sinter cake yield.

At the third one, in 2007 June it was realized the Major Repair where significant improvement in exhaust and cooler systems, in the mixer and in the ignition were obtained.

At last the main foreseen equipment for another phase in the productivity increase are described. They will have the function to increase the segregation of Carbon and grain size in the vertical direction in the bed, to improve the bed permeability and to uniform the sintering, increasing the productivity.

Yoshida(1) describes the main actions that had made in the Nagoya plant with the purpose to raise the grain size segregation, improvement of bed permeability with the use of stone remover and permeability bars. They reached an increase of 17 %.

Shibuta(2) describes the activities in Kobe plant with the objective of to increase the productivity. The improvement in pseudo particle formation, in the particle segregation in the bed and in the sintering uniformity resulted in an increase of 14 %

Saito(3) shows the sintering uniformity in lateral and vertical directions as the responsible for the increase in the sinter cake yield and in the productivity .

Takashima(4) shows the expressive effect of the air leakage reduction on the sintering productivity without changes in the blower .

Dawson(5) reviews the importance of the pseudo particle formation and of the size segregation with studies realized in feeding equipment developed in Japan in the last decades.

2 MATERIALS AND METHODS

The Cosipa's Sintering Plant nº 3 started in 1982 and it was projected to reach a productivity of 33,0 t/m^2/day.

The Figure 1 shows the annual evolution from the start up until 2004.

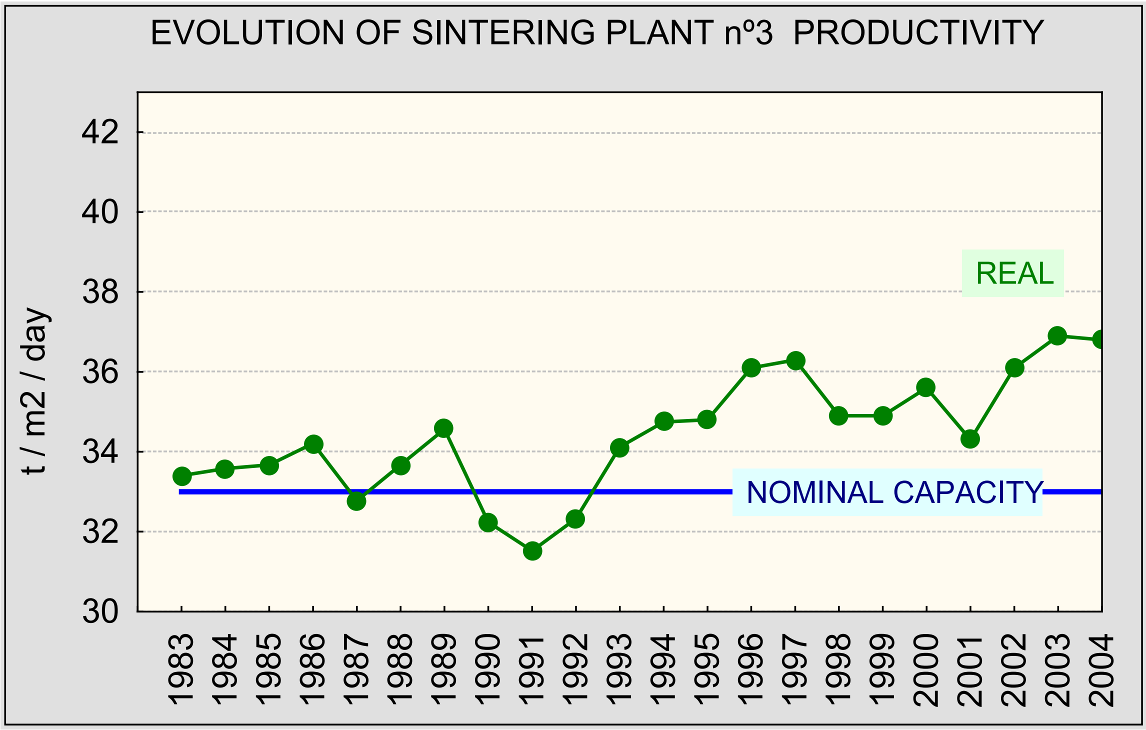

Figure 1: Evolution of Sintering Plant n° 3 from the start up until 2004 .

Thereafter, it begins an improvement period , aiming to reach 38,0 t / m^2 /day value which was considered as an attainable challenge .

The improvement period that will be described forward was realized under the same equipment and raw materials conditions except the modifications mentioned . In this way , the results can be assigned to the activities realized in each phase of this period .

This period was divided in three phases :

Phase 1 – improvements in limestone size distribution and in the lime reactivity .

Phase 2 - continuous feeding to the sintering machine and some grade of grain size and chemical segregation in the bed .

Phase 3 – Improvement in exhaust and cooler seal systems , in the ignition of the mixture and in the pseudo particle formation .

Phase 4 (will be developed) – To enhance the size and Carbon segregation in the vertical direction and to uniform the sintering in vertical and lateral directions.

3 RESULTS

3.1 Phase 1 – Improvements in the Fluxes for Sintering

The main purpose in this period was the improvement of the ability to the pseudo particle formation and of the permeability as well. Two activities were developed:

- Purchase of lime with higher reactivity. The Cosipa's limestone Calcination plant was disabled in that time.
- Request to our limestone supplier to introduce one more screen in their lay out to increase the fraction plus 1 mm and minus 5 mm and in this way the size distribution was optimized .

The Figures 2 e 3 show the lime reactivity and the limestone size before and after the changes.

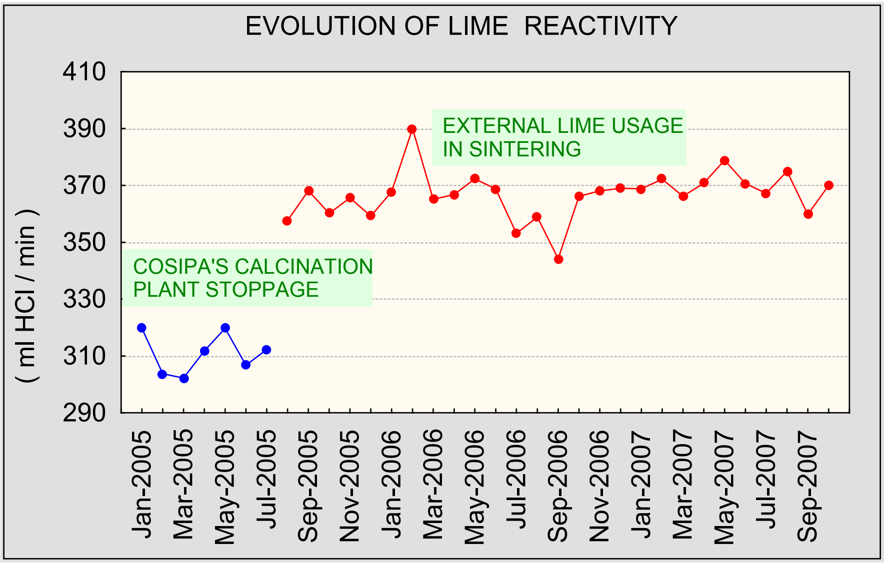

Figure 2: Evolution of lime reactivity

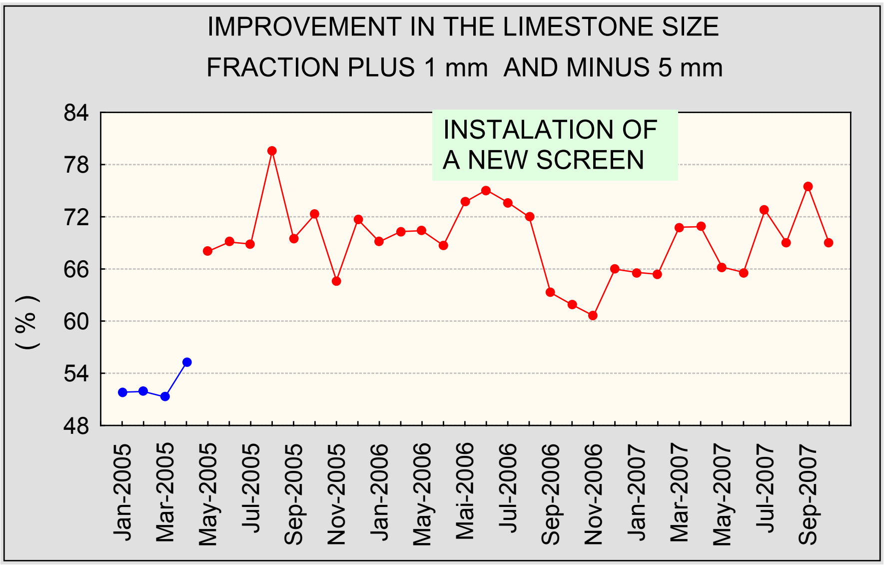

Figure 3: Evolution of the plus 1 mm and minus 5mm fraction of limestone.

3.2 Phase 2 – Improvement In The Feeding System

In this phase , the greatest interest was the optimization of the existent feeding system.

Searching for

- some grade of size and Carbon segregation in the vertical direction
- to obtain more homogeneity in lateral and longitudinal directions
- to improve the bed permeability, some activities were realized as shown in Figure 4.

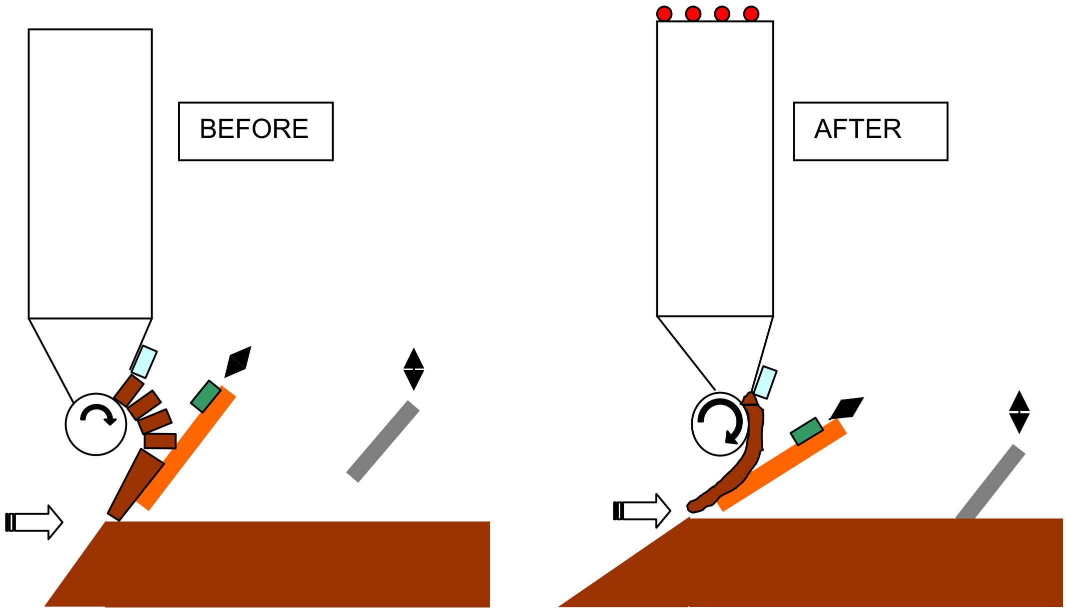

Figure 4: Changes made in the feeding system.

Initially was installed a stone remover on the top of raw material hopper . This removal allowed to close the hopper gate from 130 to 50 mm , and for such it was necessary to adequate the engine . With this procedure , the raw material changed the flow from a discontinuous called avalanche to a continuous flow .

To make easier the flow of raw material inside the hopper it was changed its frontal angle . Besides it was installed a new lining with smooth surface in the deflector plate .

To obtain certain grade of segregation , the existing blower was approximated to the raw material fall , enlarging the air shock speed aiming to drag the materials finer and less dense (as the Carbon) and locate them on the top of the bed .

At last the level plate was recovered , aiming to obtain a flat surface and in this way a sintering reaction uniform in the longitudinal direction .

3.3 Phase 3 – Improvements During the Major Repair

With detailed report of:

- Constants replacements in the ignition furnace refractory bricks , probably due its small size and fast cooling causing damages during emergency stops.
- High electrical energy consumption in the main blower due to faults in the seal system (ducts, windboxes, expansion joints etc.)
- Constants damages to the belt conveyors due to insufficiency of the sinter cooling,

It was decided to concentrate the Major Repair services for the solution of these problems.

The Figure 5 shows the main services made in the Ignition Furnace:

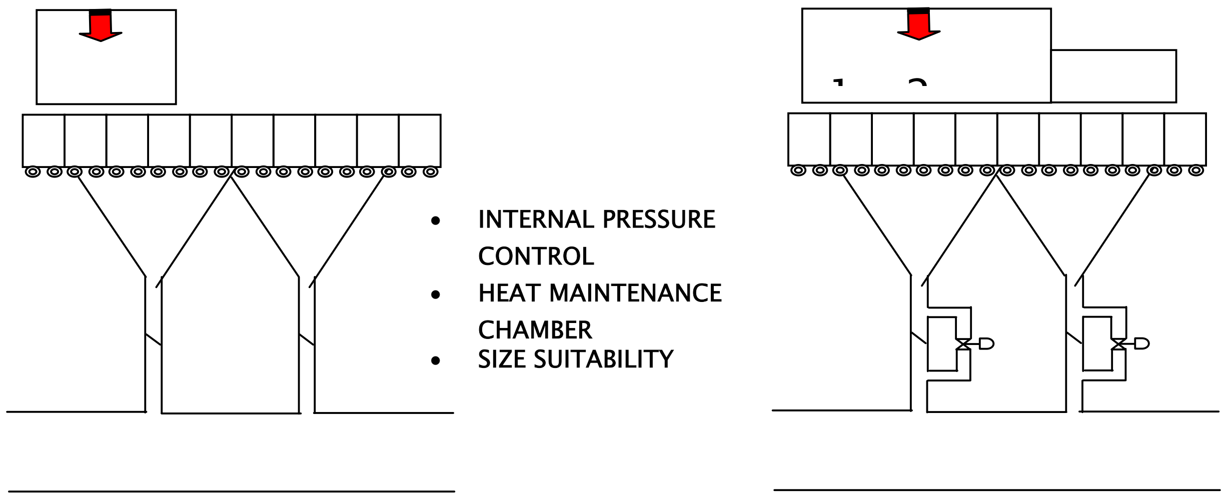

Figure 5: Ignition Furnace suitability realized during the Major Repair .

The Figure 6 shows the evolution of the oxygen concentration in the Sintering chimney, which is a fine indicator of the air leakage reduction obtained after the services of the major repair.

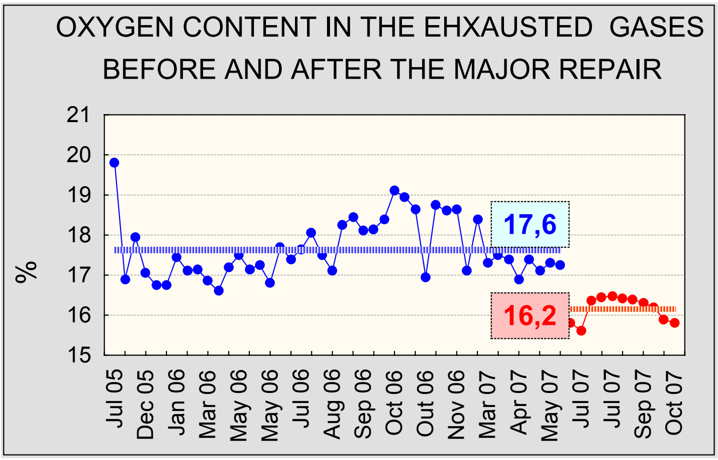

Figure 6: Oxygen content in the exhausted gases from the Sintering Plant (before and after the Major Repair)

The Figure 7 shows the main activities realized in the sinter cooling seal system.

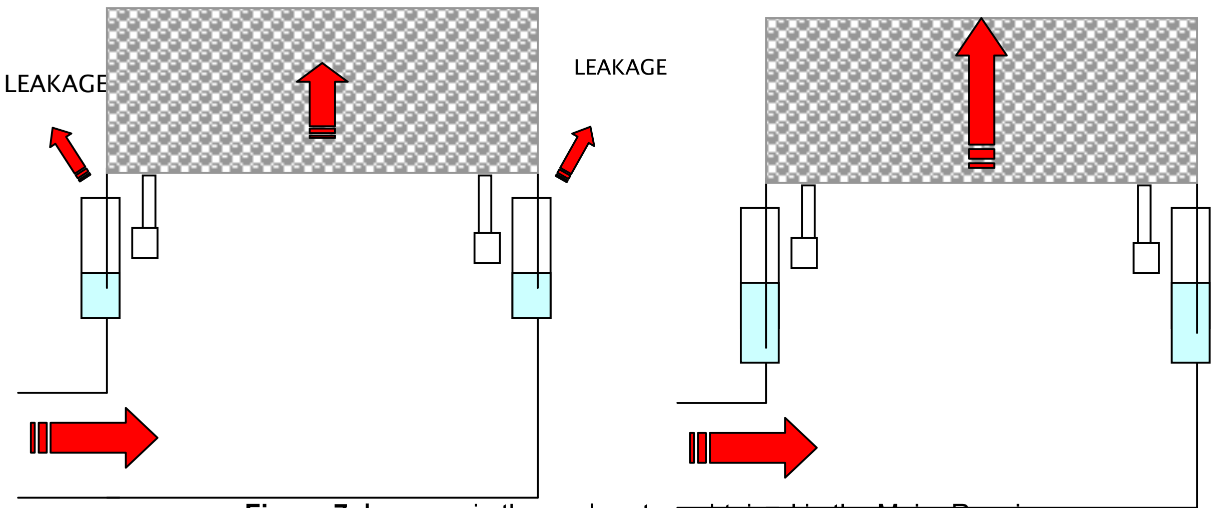

Figure 7: Increase in the seal system obtained in the Major Repair .

The Figure 8 shows how the BTP position would be moved forward after the services realized, increasing the Sintering machine utilization.

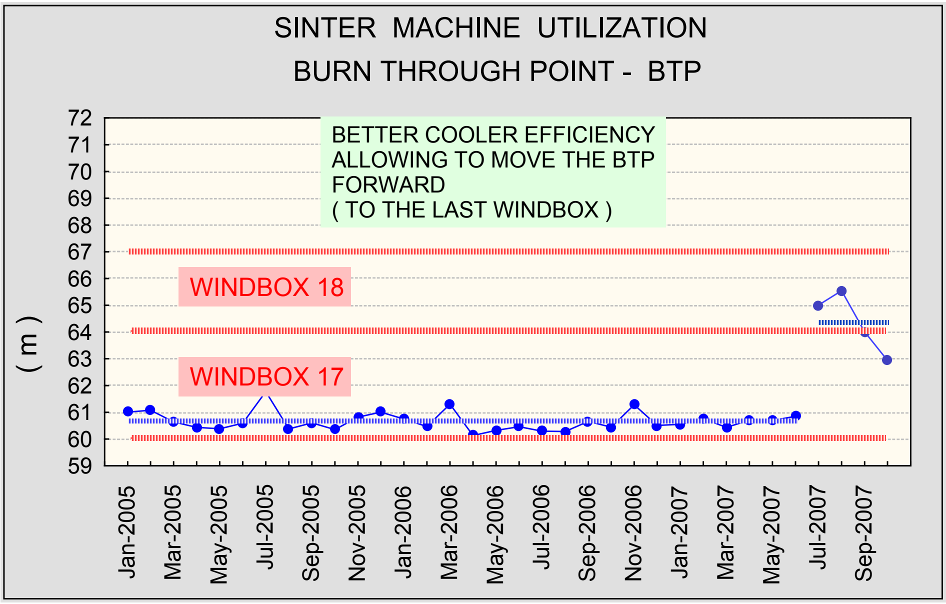

Figure 8: Change in the BTP positioning after services realized during the Major Repair.

The sum of all these activities resulted in an expressive increase in the sintering productivity as showed in Figure 9.

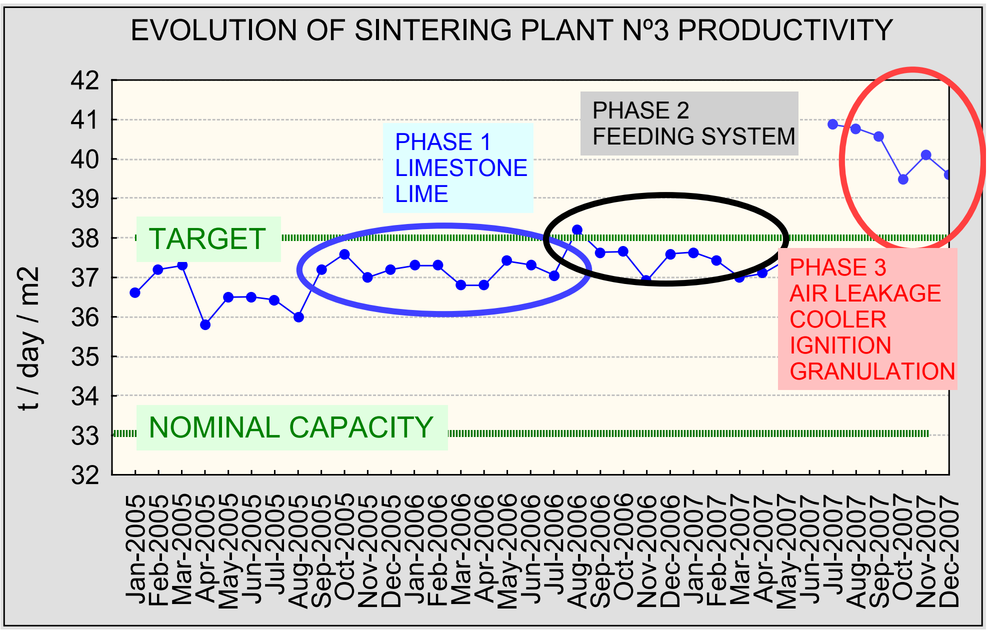

Figure 9. Evolution of Sintering Plant nº3 during the improvement period.

5 DISCUSSION

The data show how is important the sequential work oriented by results always based in fundamental concepts .

Since the first phase , with the flux improvements can be noticed a change in productivity from 36 – 37 t / m^2 / day to 37 – 38 t / m^2 / day , increasing about 3 % , similar as reported by Dawson.[5]

In the second phase, with the existent feeding system optimization, at the first time was reached the target value of 38 t/m^2/day.

In that moment it was noted the great importance of increasing the sinter cake yield. The lesser return fines generation and the need of protect the upper portion of the bed were considered the most important objective.

As observed in previous work,[6] the size and Carbon segregation can do this compensation of thermal supply in an efficient way .

As important as the obtained results, was the fact that in these phases, it was established the fundamental basis to improvement in the process . With better fluxes and feeding system equipment well adjusted, when the bottle necks (exhaust and cool seal system) were removed, all the potential could be developed.

After the Major Repair, with better pseudo particles formation, better surface ignition and lesser air leakage, it was obtained 40 t/m^2/day overcoming the expectations.

6 CONCLUSION

The raw material in proper condition , better exhaustion and cooler seal systems, good surface ignition and properly lay down of the mixture on the sintering machine showed be the fundamental aspects to increase the productivity.

Beginning with values of 36 t/m^2/day, after the improvement period, it was reached 40 t/m^2/day, what means an increase of about 10%.

Based in these results and in some pot tests conducted at USIMINAS Research Center, the next phase (phase 4) will be consisted of enhancing the size and Carbon segregation and the uniformity of sintering in lateral and longitudinal directions of the bed through the installation of:

- automatic sub gates in the raw mix hopper
- segregation system feeding (ISF – Intensified Sifting Feeder, NSC)
- permeability bars

Values around 42 – 43 t / m^2 / day are expected.

REFERENCES

1 YOSHIDA , H. ; IIDA , H. ; KABUTO , S.; SUZUKI , H. Improvement of productivity of sintering plant at Nagoya works of NSC . Ironmaking Conference Proceedings , p.373 – 376 . 1996.

2 SHIBUTA , K. ; KUWANO , K.; ITO , R . ; AWAJI , M. Recent sintering technology resulting in high productivity at Kakogawa’s sintering plant . Ironmaking Conference Proceedings , p.623 – 628 . 1990.

3 SAITO , G. ; MOTIZUKI , M.; AMAKAWA , K . ; KAMIKO , Y. Improvement of sinter yield at the large sintering machine . Transactions ISIJ , Vol. 28 , p.B-90 , 1988.

4 TAKASHIMA , N. ; TAKAHASHI , H.; SUGAWARA , M . ; TANAKA , K. Countermeasures for prevention of air leakage at sintering machine and their effects . Kawasaki Steel Technical Report N.º 15 p.9 – 15 . October 1986.

5 DAWSON , P. R . Recent developments in iron ore sintering . Ironmaking and Steelmaking , p.135 – 159 . Vol. 20 , 1993.

6 TETTI , U. Modelo matemático unidimensional do processo de sinterização de minérios de ferro . Rio de Janeiro : Departamento de Ciência dos Materiais e Metalurgia , Pontifícia Universidade Católica do Rio de Janeiro , 1991 , 151 p. Tese (Mestrado).