INTEGRATED PROJECT TO INCREASE THE ARCELORMITTAL TUBARÃO SINTER MACHINE PRODUCTIVITY [1]

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Abstract

When ArcellorMittal Tubarão decided to implement the expansion plan to increase the total production of steel from 5,0 to 7,5 tons/year,(Blast Furnace, Converter and Continuous Casting Machine), it was established a challenge to study ways to increase sinter machine productivity from 37,5 t/d/m² to 42 t/d/m². This paper aims to show step by step the alternatives to optimize and increase the productivity through raw materials, present equipments improvements and development of new technologies/equipments. The methodology for development was based on the team experience, bibliographical inquiry and high productivity benchmarking with some Japanese Sinter Plants

Key words: Productivity; Benchmark; Stability

PROJETO INTEGRADO DE ELEVAÇÃO DA PRODUTIVIDADE DA SINTERIZAÇÃO DA ARCELORMITTAL TUBARÃO

Resumo

Quando a ArcelorMittal Tubarão decidiu implementar o plano de expansão para aumentar a produção de placas de 5,0 para 7,5 Mt/ano, foi estabelecido um desafio para estudar alternativas para aumentar a produtividade da maquina de sinter de 37,5 t/d/m² para 42,0 t/d/m². O trabalho visa mostrar passo a passo as alternativas avaliadas para otimizar e aumentar a produtividade através dos seguintes pontos: Matérias primas; estabilização e otimização dos equipamentos existentes e busca de novas tecnologias. A metodologia para desenvolvimento do trabalho foi baseada em extensa pesquisa bibliográfica, além de busca de referencia (Benchmark) com maquinas de sinterização Japonesas que operam com altos níveis de produtividade.

Palavras-chave: Produtividade; Sinergia, Estabilização.

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1 INTRODUCTION

When ArcelorMittal Tubarão decided to implement the expansion plan to increase the total production of steel from 5,0 to 7,5 tons/year (Blast Furnace, Converter and Continuous Casting Machine), it was established a challenge to study some ways to increase sinter machine productivity from 37,5 t/d/m² to 42 t/d/m². Aiming to get information to the present study, and besides the bibliographic reference, a mission was sent to Japan in September 2003 in order to visit 4 sinter plants with useful area bigger or equal to 350m^2 and productivity varying from 40,00 to 48,00 t/d/m², establishing crucial references to obtain high productivity results (Figure 1).The information got from the mission, the bibliographic references and the experience of the group pointed to aspects related to raw materials, improvement on the existing equipment and the development of new technology/equipments. From that, a working plan aiming to reach the proposed results was outlined.

Benchmark Japanese Plant: Productivity

A	B	C	D
45,14	48,71	44,64	40,00

Raw Materials

T. M Mix (mm)	Lime		Fuel Mix
	Participation (%)	Size (mm)	
> 3,00	From 2,50 to 3,00	100% < 1,00mm	> 70% of Coke

Sinter Quality

Basicity	CaO (%)	MgO (%)
> 2,00	> 10,00	<1,20

Equipments

Mixture Preparation	Cooling System
Mixer + Nodulizer	Cooling area bigger than machine area
Pre -treatment of recirculated	

Figure 1: Main Benchmark aspects with Japanese Sinter Plants.

2. MATERIALS AND METHODS

2.1 Working Flowchart

The flow chart (Figure 2) was established through the references available, considering and detailing the main frames, that is, the raw material, improvement on the existing equipments and the development of new technology/equipment, establishing the team in charge of evaluating new raw materials and the economical return, after the detailing, specification, engineering and implementation of new equipments, as well as improvement of the existing ones.

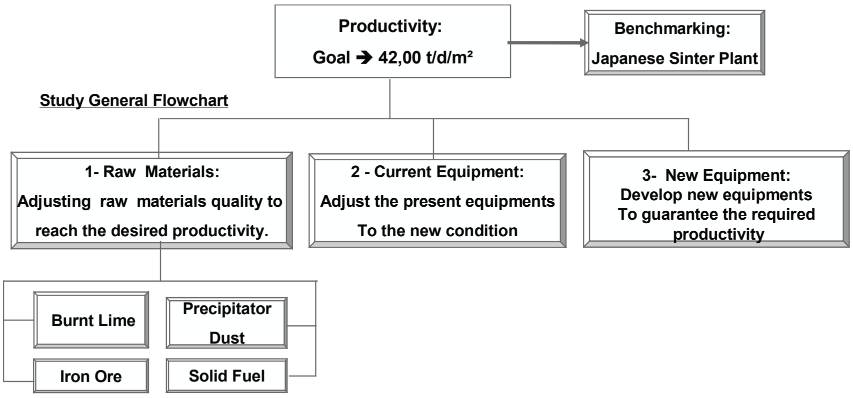


Figure 2: Study General Flowchart

2.2 Raw Materials

2.2.1 Burnt lime

The burnt lime addition improves the permeability and thus, productivity, through intensification of micro palletizing of the ultra fine particles, and aiming to reach the target of 42,00 t/d/m², it was decided to use 2,0% of lime in the mixture with the granulometric distribution 100% below 1,00mm (references graphic Figure 3).
To attend the new requirement, in reference to volume and granulometry, it was adjusted the capacity of the new calcinations' Kilns and implemented a new crusher (Lhoist Project). At the Sinter Plant it was increased the Burn Lime Feeding System considering the installation of a new Pneumatic Conveyor Line and a new bin, as well increasing the plant capacity Figure 3: Influence of participation and granulometry lime on productivity

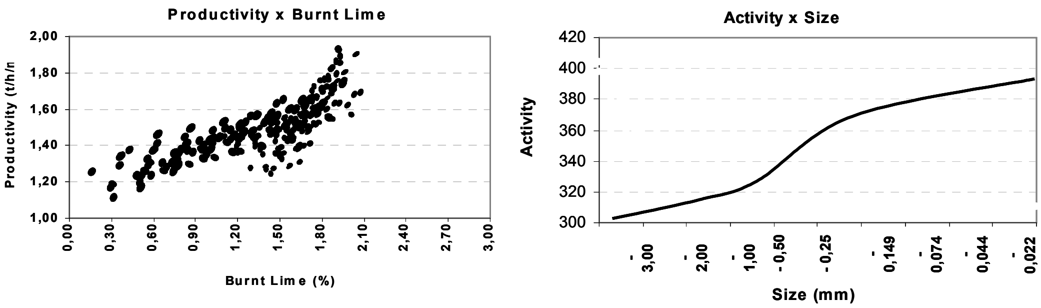


Figure 3: Influence of participation and granulometry lime on productivity.

2.2.2 Iron ore

The development of the new iron ore mixture was a joint work between Vale and ArcelorMittal Tubarão along 2005 and 2006. The objective of this Project was to evaluate a mixture of high performance in productivity. Six (6) different types of ore mixture were tested (Figure 4), always confronted with the reference mixture (used until 2007) ; the mixture that showed the best performance (Mix IV) increased about 2,35% or ~1,2 t/d/m² in productivity. This productivity is associated to the maximizing of "**Supergenic"** ore that favors the cold agglomeration, but increasing AL2O3 and P. The .Industrial tests with "MIX IV" were carried out in September 2007, and they pointed to gains smaller than the ones obtained in experimental scale.

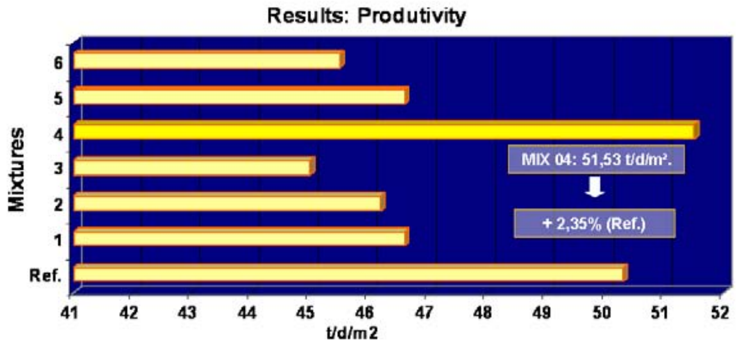


Figure 4: Productivity of the mixture tested in Experimental Scale.

2.2.3 Solid fuel

The coke grinding station was originally designed in 1983 to prepare dry coke breeze smaller than 25mm, from CDQ of the Coke Plant. However, this condition changed when anthracites started to be used in the Sinter Plant. Since the market makes available only products with very fine granulation and high moisture content, such condition was then, incompatible with the original grind station project, necessary to be operated with high feeding rates (t/h) and low bar load, changing radically the "ROD MILLS" working conditions, affecting the fuel size distribution, affecting though, the process performance. Figure 5 shows the effect of the granulometry on the process.

SIZE	CHARACTERISTICS IDENTIFIED IN THE PROCESS	EFFECT
>3,00mm	• Irregular burnt by lack of uniformity of thermal distribution at layer • Low front frame speed • Skull at the bottom of the pallet	•Decrease of yield causing Increase in specific coke consumption and decrease in productivity.
3,00 ~ 0,25mm	•Uniform thermal distribution at the layer • Frame front speed compatible with thermal exchanges necessary to the process	•Optimized combustion efficiency improving results of yield and productivity
< 0,25mm	•High frame front Sinter speed with insufficient heat exchange • Ultra fine coke wrapped by the ore, affecting its combustion	•Decrease of yield causing Increase in specific coke consumption

Figure 5: The Influence of the different fuel size distribution on the process.

Aiming to rearrange the system operation due to the increase in anthracite consumption on the fuel mix, a project of improvement on fuel treatment system was implemented. The improvements consisted of increasing the system capacity, replacing the two existing screens by new ones of high efficiency to moist materials and closing of circuit after grinding, using only the "UNDER SIZE" of screen on the Sinter Plant. These measures aim to obtain products with high content rates on granulometric range between 0,25mm e 3,15mm, more efficient to the process. Figure 6 shows the impact on anthracite quality after start-up of the operation with closed circuit.

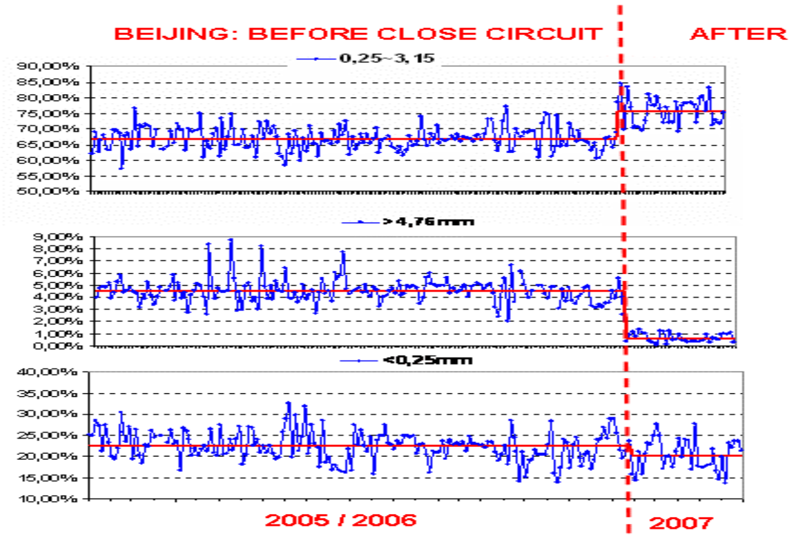


Figure 6: Performance of anthracite size distribution treated on the new plant.

Another two important aspects were contemplated by this investment

- The possibility of using and mixing two different types of anthracite, with different qualities but complementing characteristics, obtaining a high quality product that fulfills production and environment necessities.
- The preparation of "SMALL COKE" on a system used exclusively with fuel, avoiding the contamination of the fines generated during screening; condition that gave more stability to the process, seeking to eliminate the variation of fixed carbon on fine coke (This material was previously prepared at the ore yard).

2.3 Equipment Adjusts to Fit the New Condition

2.3.1 Discharge chute to cooler

The main objective of this project was the improvement of the sinter distribution over the cooler, in a way that the gross material will be at the bottom, the fine material above and medium material will be at the upper part of the cooler cars, making it possible to improve the air flow and heating exchanging in order to reduce the sinter discharge temperature. According to that the chute was revamped in February 2006, based on Outotec`s material segregation technology. After revamp it was possible to increase the productivity around 3,5%. Figure 7 shows the layout of the new chute.

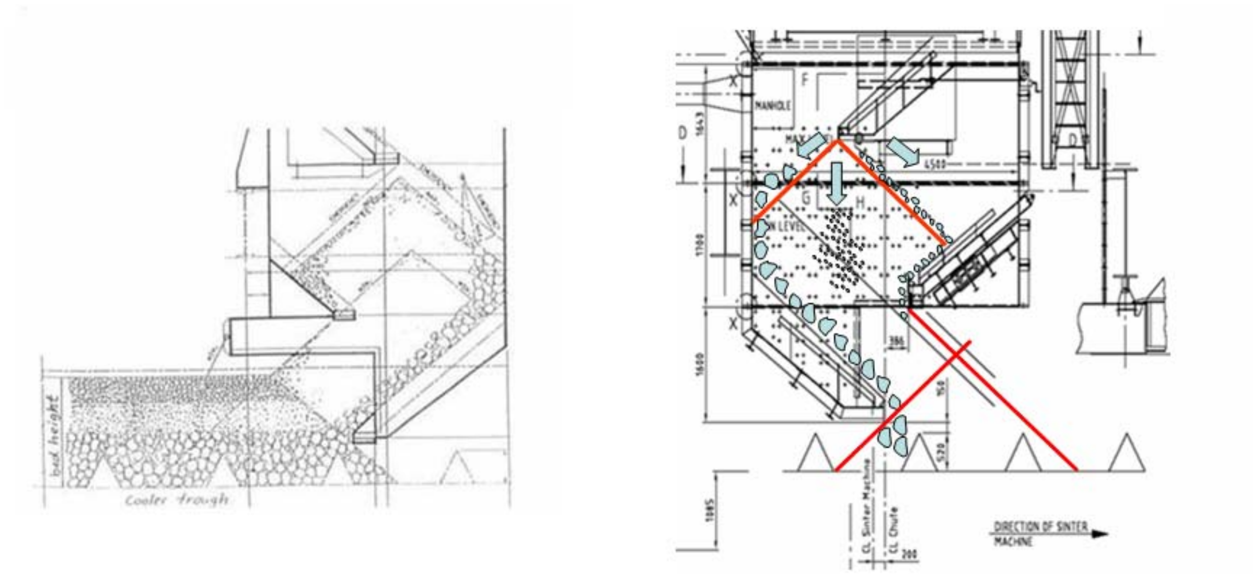


Figure 7: Layout of the new discharge chute to the cooler

2.3.2 Development of belt conveyors resistant to high temperature

A partnership with belt conveyor manufacturers was created with a view to researching and developing high temperature and abrasion resistance belt conveyors; and it was selected a manufacturer able to manufacture a belt that supports average temperature of 200ºC, with peaks of temperature around 400º and 60 days of useful life.

2.4 Development of New Equipments Aiming to Guarantee the Target Productivity

2.4.1 Improvement of material mixing system

To reach the target productivity with high rates of burnt lime and the new ore mix, it was necessary to enhance the mixing time to guarantee the process of micro pellets formation.

The improvement of the mixing system consisted of the installation of a new mixer, and the changing of the existing one into nodulizer, as well as the improvement of its capacity. The Figure 8 below shows the new layout and the impact of its improvement on the mean size of the new micro pellets.

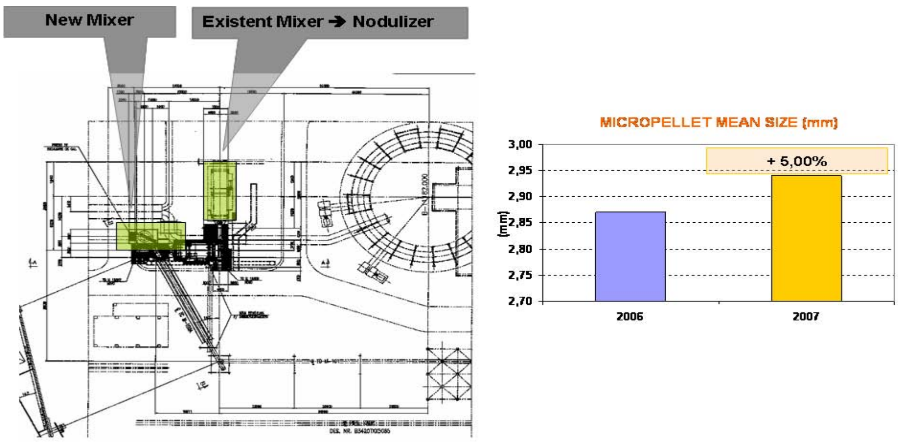


Figure 8: New Mixing System and the evolution in the micro pellets mean size

2.4.2 Electrostatic precipitator dust dosage system

Until June 2007, the dust generated in the secondary precipitator (Dedusting of the area), about 200 t/d, was recirculated to the process through RETURN FINES. This condition used to cause variations on the mixture permeability due to some differences in behavior of the two materials in the dosage; such variations would cause instability to the process and productivity losses. Aiming to eliminate this interference, it was implemented a new system that consisted on the installation of a new Pneumatic Conveyor Line and the adaptation of the existent burnt lime bin, making it possible to dosage this dust separately of the return fines. Figure 9 shows the "system layout".

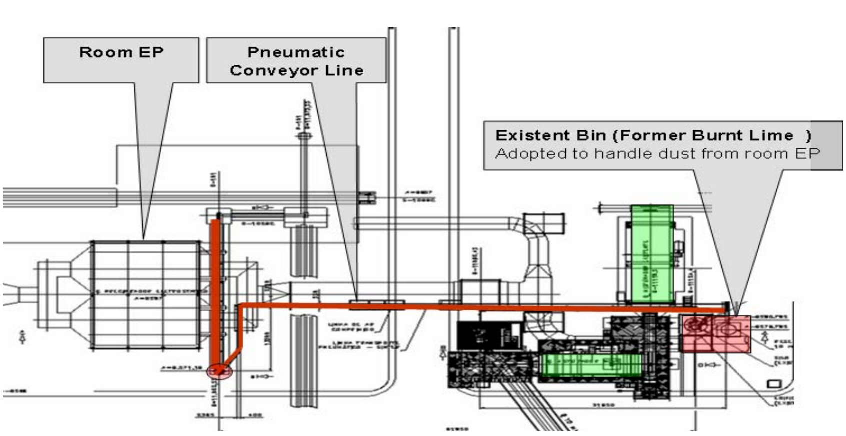
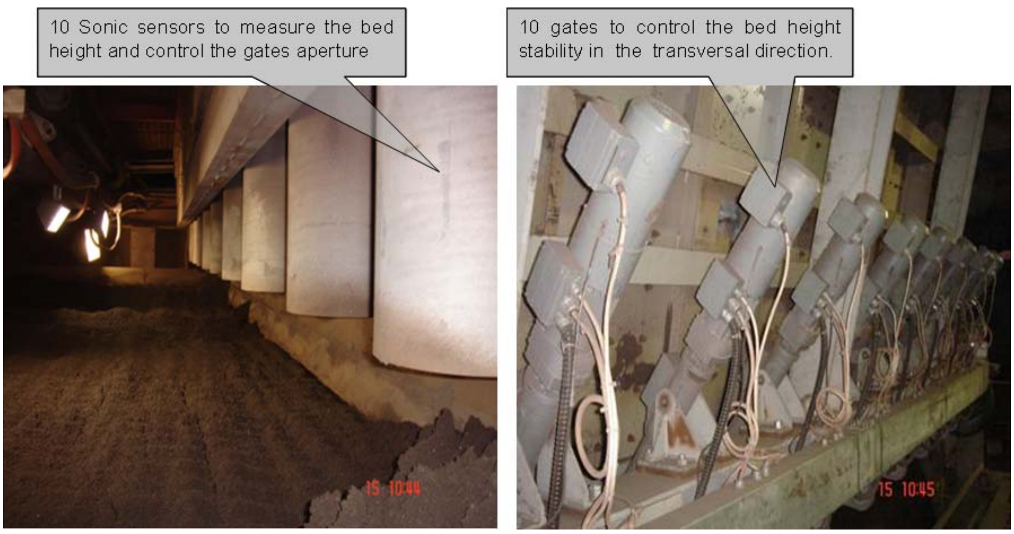


Figure 9: New Electrostatic Precipitator Dust Dosage System

2.4.3 Improvement of sinter machine feeding system

An important aspect to guarantee the stability of the process refers to the stability during the machine feeding, mainly on transversal way. This condition of stability can be achieved trough an efficient height control system to improve bed height and layer density. The improvement on the Machine Feeding System consists of the installation of 10 new gates, replacing the former six, and sonic sensors to monitor the bed height, optimizing the height control and bed density. Figure 10 shows the new configuration of the new system.



3 RESULTS AND CONCLUSIONS

It was possible to reach the target results (42, 00 t/d/m²) through some adjusts on raw material equipments, beside some investments to upgrade on existing equipments and to introduce new ones. Figure 11 shows a graphic of the productivity from 2005 to 2008, where the main achievements are highlighted:

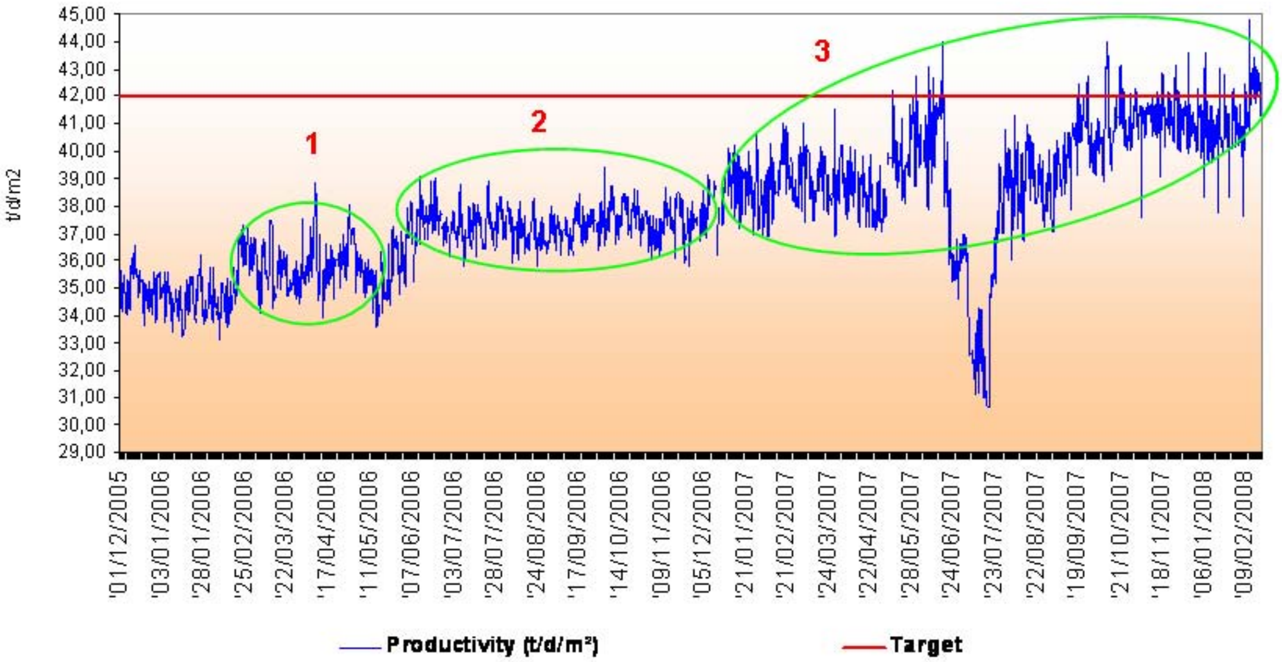


Figure 11: Productivity from 2005 to 2008

1- Implementation of a chute at the cooling charging chute in order to improve sinter segregation, in February 2006.
2 – Through cooling performance improvement, it was possible to take advantage of the same iron ore mix increasing burnt lime participation (from 0,80% to 1,80%) in order to increase the productivity,
3- The results show an improvement , after investments in December 2006, in terms of permeability and stability, making it possible to increase the bed height in 40 mm, reducing the fuel rate in 1 Kg/t and enhancing the productivity to the target value (42,00 t/d/m²), in June, 2006. (From June to September 2007, it showed a decrease due to the delay on Blast Furnace III Blow In).

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