

# CSN IRON ORE BUSINESS – A NEW INTERNATIONAL PLAYER <sup>1</sup>

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## **Abstract**

Companhia Siderúrgica Nacional (CSN Steel Company) which is 100% owner of Casa de Pedra Iron Ore Mine (CdP) and 60% of Nacional Minérios S.A. (NAMISA), accounts for the majority of its iron ore supply, producing lump ore, sinter and pellet feeds with high iron ore content and great physical properties. Casa de Pedra and NAMISA have a vast reserve and ore rated as a world class mining assets. The paper shows a brief history, their current situation as well as the production master plan with the expansions. The iron ore products performance in sintering and blast furnace process at CSN Steel Company are also described and analyzed.

**Key words:** Iron ore mine; Iron ore products; Sintering; Blast furnace performance.

## **CSN E SEU POSICIONAMENTO COMO FORNECEDOR DE MINÉRIO DE FERRO NO MERCADO INTERNACIONAL**

### **Resumo**

Companhia Siderúrgica Nacional (CSN) detem 100% da Mina de Casa de Pedra (CdP) e 60% da Nacional Minérios S.A. (NAMISA), as quais são responsáveis por suprir quase a totalidade de sua carga metálica. Os produtos granulado, sinter e pellet feed são reconhecidos pela seu alto teor de ferro e excelente qualidade física. Casa de Pedra e NAMISA têm vastas reservas e seus produtos são ranqueados em alto conceito no mercado mundial. Este trabalho apresenta um breve histórico do desenvolvimento das minas, as fases atuais de produção e os planos de expansão. É apresentado também o desempenho destes produtos nas sinterizações e nos altos fornos da Companhia Siderúrgica Nacional.

**Palavras-chave:** Mina de minério de ferro; Produtos de minério de ferro; Desempenho de sinterizações e altos fornos.

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# 1 INTRODUCTION

Companhia Siderúrgica Nacional (hereinafter - CSN) is an integrated steel company, currently producing around 5.5 Mtpy of steel, has in the iron ore an important role to provide competitiveness on its steel products final costs. Based on that, CSN has been receiving, since the start up, iron ore from its own mine, called Casa de Pedra Iron Ore Mine (hereinafter - CdP), which supplies the sinter plants and blast furnaces with sinter feed and lump ore.

The operational sinter plant and blast furnace data, both equipments fed with almost a 100% of CdP products are classified as world class benchmark.

Promoted by the China's steel production raise, CSN has decided to increase the iron ore output production based on two different ways. The first one was the acquisition of some iron ore mines with the creation of a new company called Nacional Minérios S.A. (NAMISA). The second one was based on huge investments in CdP and NAMISA, in order to allow CSN to, in the next few years, produce almost 5 times more in 2008.

In order to support its expansions plans, CSN looked for strategic partners and made a merger with Asian Companies.

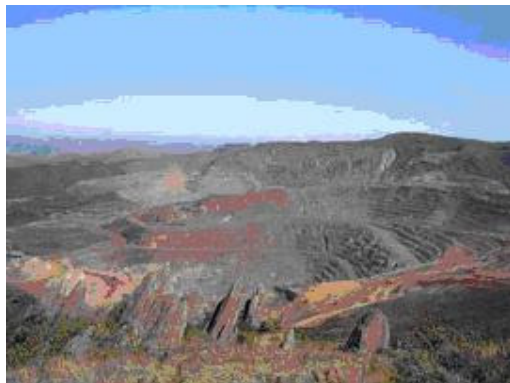
## 2. DEVELOPMENT

### 2.1 Casa de Pedra Current Status

The CdP Mine is located at Congonhas, State of Minas Gerais, in the Brazilian Iron Ore Quadrangle. It accounts for almost all CSN iron ore consumption, producing lump ore, sinter and pellet feeds with high iron content and superior physical properties. The mineral reserves and resources at Casa de Pedra Mine are incredibly vast and it is rated as a world class mine.

The Mine has a total of 8.4 Billion tons (Bt) of resources of iron ore at a grade of 41.3% Fe (36.6% SiO<sub>2</sub>).

In 2008, Casa de Pedra produced around 4.6 Million tons (Mt) of lump ore, 9.4 Mt of Sinter Feed and 3.4 Mt of Pellet Feed. The current plant has a capacity of 21 Mtpy, after some improvements made in the mine last year. The main processing stages are: crushing, screening, classification, flotation and filtration. The Figure 1 shows respectively the general view of the pits and the operational flow chart.



**Figure 1:** CdP General View of the Main and the Western Pits and the operational flow chart.

## 2.2 Namisa Current Status

Namisa now is a company belonging to CSN with 60% stake and an asian group hereinafter called Consortium with another 40%. The Consortium is consisted of six Japanese and one Korean companies, according to Table 1.

**Table 1** – The Namisa and Consortium compositions

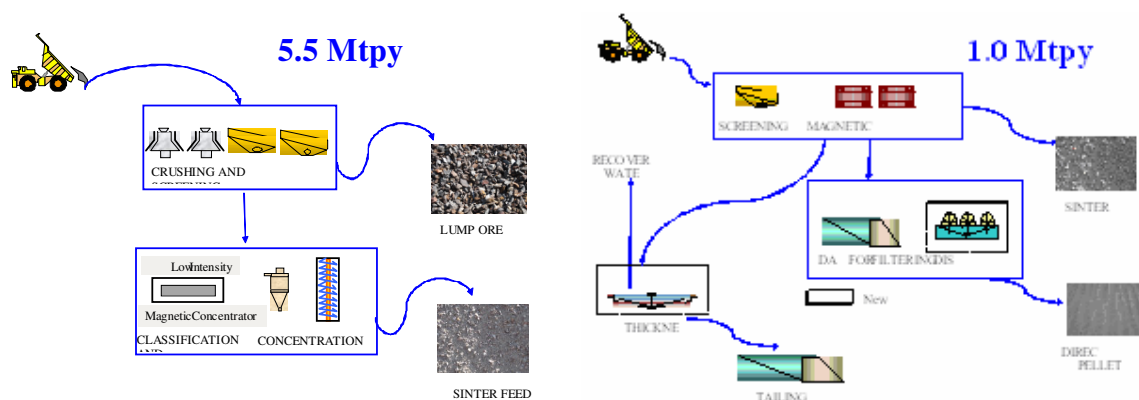
NAMISA COMPOSITION		CONSORTIUM COMPOSITION	
CSN	60.00 %	ITOCHU Corporation	40.00 %
Consortium	40.00 %	JFE Steel Corporation	16.20 %
		Nippon Steel Corporation	16.20 %
		Sumitomo Metal Industries, Ltd.	3.08 %
		Kobe Steel, Ltd.	1.75 %
		Nisshin Steel Co., Ltd.	16.20 %
		POSCO	16.20 %

Its mining operations are also carried out in the state of Minas Gerais, in the Brazilian Iron Ore Quadrangle. The Engenho mine, in particular, contributes with the bulk of the Namisa total iron ore production.

Namisa holds 09 mining concessions located in the main geostructural units and which are part of Pires Beneficiation Plant Complex and Fernandinho Complex.

The Pires Complex encompasses 4 iron ore mines (Engenho, Nogueira Duarte, Argentina and Sobramil), 2 deposits (Pedra Preta and Água Santa), 2 tailing dams, Pires beneficiation plants (main plant and magnetic concentrator) and Pires loading rail terminal (Itacolomy - TFI). The products derived from this complex are Lump Ore, Sinter and Pellet Feeds. Its main processing stages are: crushing, classification, and concentration (Humphrey spirals, cyclones and low intensity magnetic separator). Its current production capacity is 5.5 Mtpy from the Pires beneficiation plant and 1.0 Mtpy, from a total of 3.0 Mtpy, already being produced in the Pires magnetic concentrator.

In 2008, Pires and Fernandinho Complex produced around 1.4 Mt of lump ore, 3.0 Mt of Sinter Feed and 0.6 Mt of Pellet Feed.



**Figure 2:** Simplified Pires Complex Production Flow Chart.

The Fernandinho Complex encompasses 01 iron ore mine (Fernandinho I), 2 deposits (Fernandinho II and Cayman), 3 tailing dams, Fernandinho I beneficiation

plant (main plant and magnetic concentrator) and Fernandinho loading rail terminal (TFF).

The Fernandinho I beneficiation plant currently has a production capacity of 0.6 Mtpy of Sinter Feed and its main processing stages are: crushing, classification, and low field magnetic concentration.

### 2.3 Itaguaí Port Current Status

CSN (Casa de Pedra and Namisa) is fully integrated with railroad and port facilities, which is able to supply ore on FOB basis to customers worldwide. The port is located in the state of Rio de Janeiro.

The port facilities include car dumper, conveyor belts, bins, transfer points, stacking and reclaiming lines, stackers, reclaimers, and ship loader. The port started its operation with a capacity of 7 Mtpy in 2007 and since February 2008 operates with a capacity of 30 Mtpy and this phase in conjunction with the previous one are able to unload 2 trains simultaneously, reaching a capacity of 11,800 t/h and increasing the materials static storage capacity to 1.8 Mt.



Figure 3: Itaguaí Current Operations.

### 2.4 Casa de Pedra and Namisa Resources

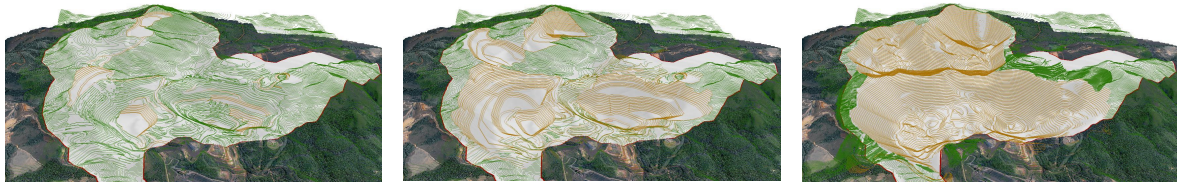
The Table 2 below shows the total resources and iron contents of the Casa de Pedra and Namisa mines and deposits.

Table 2 – Resources and Iron Contents of the Casa de Pedra and NAMISA Mines and Deposits

	Resources (Bt)	Fe (%)
Casa de Pedra	8.4	41.3
NAMISA	3.2	42.2

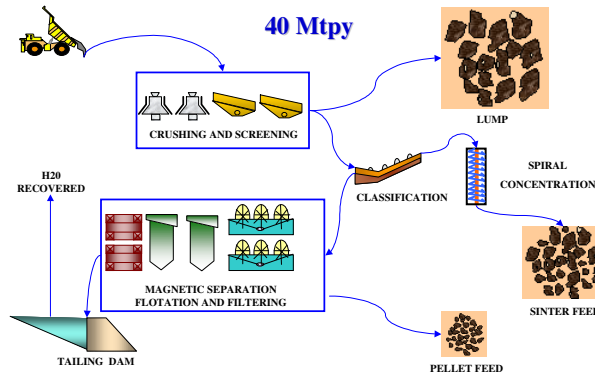
### 2.5 Casa de Pedra Expansion Plan

CSN's Long Term Planning Department has carried out a recent Final Pit Project for the Casa de Pedra Mine considering the same parameters used during the 2006 international audit as well as all lithologies which are technically and economically capable of generating iron ore products. The main difference when compared to the previous study is the possibility to generate products from Compact Poor Itabirites (IPC). The Figure 4 shows the evolution of CdP iron ore mine.



**Figure 4:** Current Pit, 2012 Pit and Final Pit of CdP Iron Ore Mine.

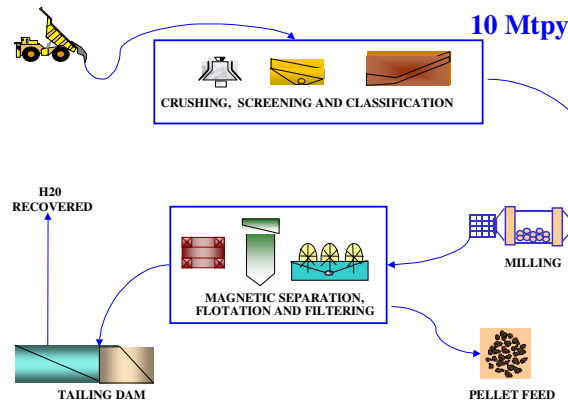
The current plant is under expansion to 40 Mtpy of capacity. The main processing stages are: crushing, screening, magnetic and spiral concentration, flotation and filtering, according to Figure 5.



**Figure 5:** Casa de Pedra 40Mtpy Plant Flow Chart.

Further expansion on CdP shall be achieved through pellet feed production (natural base, with 9% moisture) from one iron ore beneficiation plant which is independent from the existing installations and originated from ROM with high SiO<sub>2</sub> grade.

The project involves all the necessary units for the production of pellet feed (PF), including grinding and concentration, in one plant with capacity of 10 Mtpy according to Figure 6.



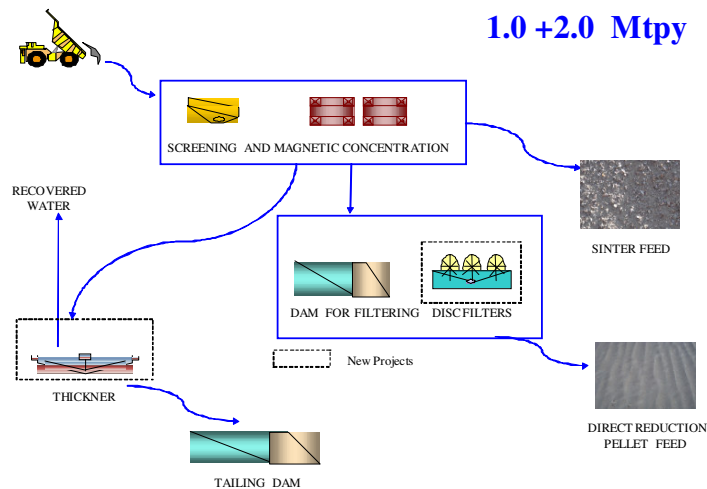
**Figure 6:** Casa de Pedra 10Mtpy Plant Flow Chart.

After these expansions Casa de Pedra will be able to produce 50 Mtpy of iron ore products.

## 2.6 Namisa Expansion Plan

Namisa also has a huge expansion plan based on the existing resources and its facilities implementation has already been approved by the board of CSN and the Consortium.

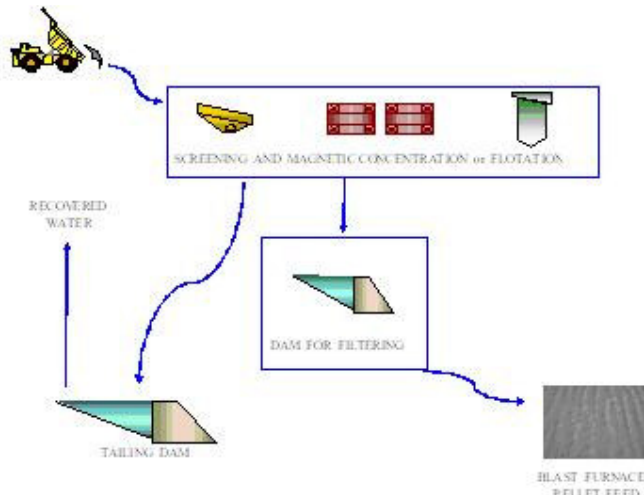
The Pires magnetic concentrator, which feeding system will be independent from the current Pires Plant, will improve the capacity from the current 1.0 Mtpy to 3.0 Mtpy. All the production from these concentrators is and will be of Direct Reduction Pellet Feed and Sinter Feed. Its main processing stages are showed in Figure 7.



**Figure 7:** Pires Simplified Magnetic Concentration Production Flow Chart.

The new Fernandinho II Beneficiation Plant will have a production capacity of 3.0 Mtpy of blast furnace Pellet Feed and its main processing stages are: crushing, classification, grinding, and magnetic concentration (WHIMS). Fernandinho II mine (greenfield project) will supply the concentration plant.

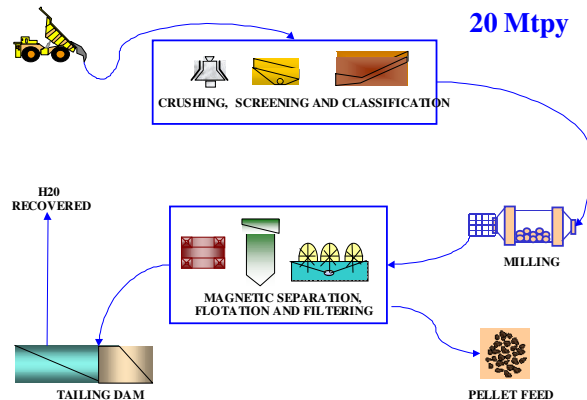
Others 03 units will be destined to recover tailing dams (Pires, Fernandinho and CdP) with maximum production capacity of 7.1 Mtpy of Blast Furnace Pellet Feed. These projects are currently underway and they are expected to be fully installed in early 2009. Figure 8 shows the flow chart of these tailing dams recovery plants.



**Figure 8:** Flow Charts of Tailing Dams Recovery.

Further expansion on NAMISA shall be achieved through pellet feed production (natural base, with 9% moisture) from one iron ore beneficiation plants which are independent from the existing installations and originated from ROM with high SiO<sub>2</sub> grade.

The project involves all the necessary units for the production of pellet feed (PF), including grinding and concentration, in one plant with capacity of 20 Mtpy according Figure 9.



**Figure 9:** Namisa 20 Mtpy Plant Flow Chart.

The pelletizing project will have a total production of 12.0 Mtpy, through the construction of two pelletizing plants of 6.0 Mtpy each. The project of the first plant will be built in the municipality of Congonhas-MG, close to the loading rail terminal of the Casa de Pedra Mine, starting up in 2011. The second plant, will be started up in 2012. The Figure 10 shows the pelletizing plant flow sheet.

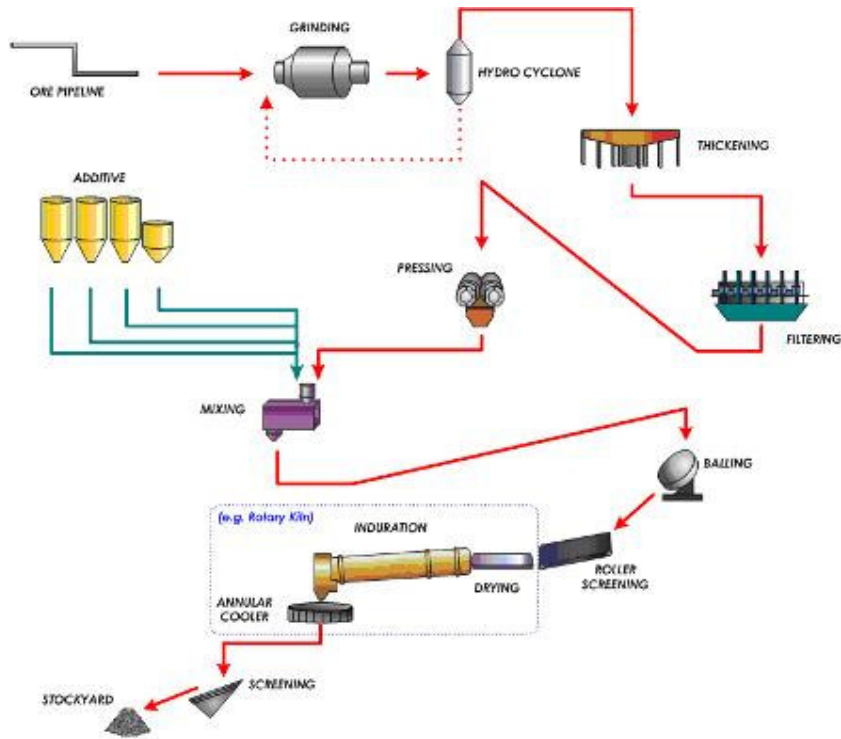


Figure 10: Pelletizing Plant Flow sheet.

## 2.7 Itaguaí Port Expansion Plan

The expansion of CSN's port terminal at Itaguaí in the state of Rio de Janeiro was divided into 5 phases. The first 2 phases (7 and 30 Mtpy) are already in operation.

The phases 3 to 5 will be developed by the installation of the following equipments/facilities: stacker-reclaimers, screening system, belt conveyors, car dumper, ship loader and stockyards.

These phases will increase the port capacity from the current 30 Mtpy to 100 Mtpy, passing through 45 and 65 Mtpy phases.



## 2.8 Implementation Schedule

**Table 3.** Implementation schedule

Casa de Pedra	
Phase II - 40 Mtpy	apr/2009
Phase III - 50 Mtpy	dec/2012
Itaguaí Port	
Phase III - 45 Mtpy	oct/2009
Phase IV - 65 Mtpy	dec/2010
Phase V - 100 Mtpy	dec/2012
NAMISA	
Engenho/Sto. Antonio Plant - 8.5 Mtpy	apr/2009
Pires Tailing Dam - 10.6 Mtpy	apr/2009
Fernandinho Tailing Dam - 1.7 Mtpy	apr/2010
Fernandinho II Concen. Plant - 3 Mtpy	apr/2012
CdP Tailing Dam - 3.3 Mtpy	oct/2009
High Silica Itabirite Plant - 20 Mtpy	aug/2012
Pelletizing Plant 1 - 6 Mtpy	dec/2011
Pelletizing Plant 2 - 6 Mtpy	oct/2012

## 3 - CdP AND NAMISA PRODUCTS QUALITY

Table 4 shows the chemical and physical quality of the products performed at Casa de Pedra and Namisa facilities. All these products are characterized by low alumina contents, very important item mainly for European and Japanese iron making markets.

**Table 4 – Chemical and Physical Quality of the Products**

	Sinter Feed	Pellet Feed	Lump Ore		Sinter Feed	HS Sinter Feed	Concentrate	Pellet Feed
	CdP	CdP	CdP		NAMISA	NAMISA	NAMISA	NAMISA
Fe	64.2	67.0	65.0	Fe	64.3	62.5	66.0	67.0
SiO <sub>2</sub>	5.00	2.10	3.80	SiO <sub>2</sub>	4.90	6.80	3.50	2.40
Al <sub>2</sub> O <sub>3</sub>	1.00	0.70	1.10	Al <sub>2</sub> O <sub>3</sub>	1.00	1.50	0.60	0.50
P	0.045	0.035	0.055	P	0.060	0.060	0.050	0.030
Mn	0.30	0.30	0.40	Mn	0.30	0.30	0.20	0.20
LOI	1.40	0.90	1.90	LOI	1.50	2.00	1.10	0.80
+ 1.0 mm	52.0			+ 1.0 mm	48.0	50.0	5.0	
- 0.150 mm	22.0			- 0.150 mm	28.0	30.0	75.0	
+ 0.150 mm		5.0		+ 0.150 mm				10.0
- 0.045 mm		40.0		- 0.045 mm				45.0
+ 50.0 mm			2.0					
- 6.3 mm			20.0					

1. Size distribution cumulative retained (%)

2.0 Expect quality at port

## 4 - CdP AND NAMISA SALES EXPORT PLAN

Table 5 presents the products available for the external market 2009 onwards

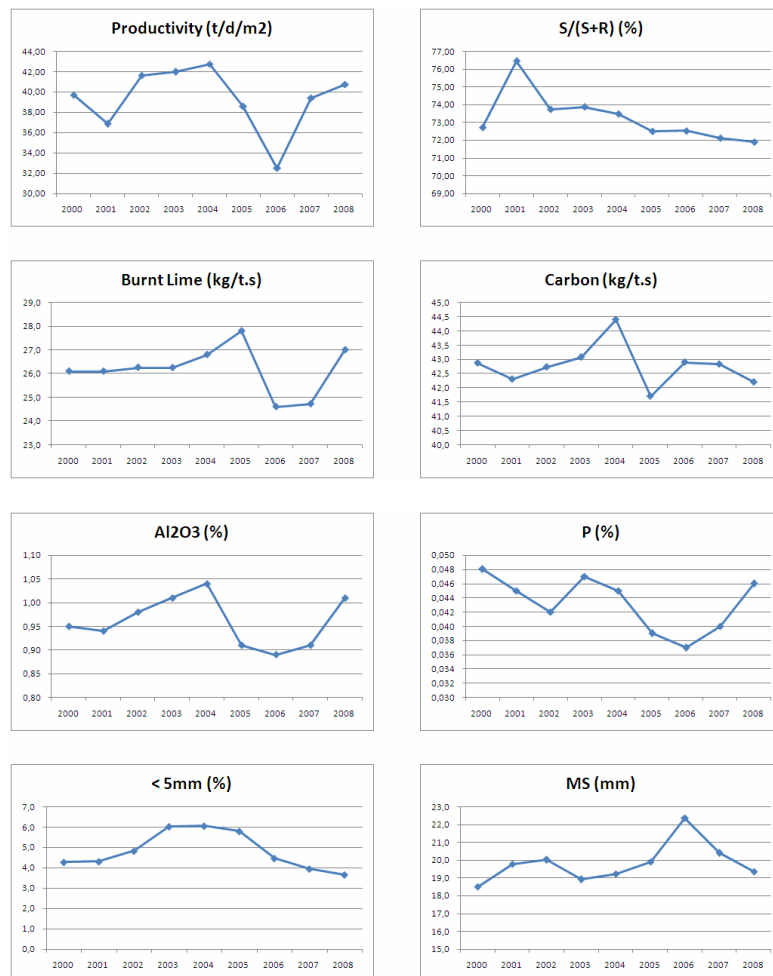
**Table 5 – CdP and NAMISA Sales Export Plan\***

COMPANY	2009	2010	2011	2012	2013
NAMISA	16,184	21,281	21,281	30,231	38,364
CSN	13,572	30,569	37,669	36,719	45,286
<b>TOTAL</b>	<b>29,756</b>	<b>51,850</b>	<b>58,950</b>	<b>66,950</b>	<b>83,650</b>

\* February 2009

## 5 SINTERING AND BLAST FURNACE OPERATIONAL DATA/RESULTS

The following graphics show the performance of 100% feed of CdP iron ore products at CSN's sintering and blast furnace plants. The main results that we would like to emphasize are the high productivity of such metallurgical equipments as well as the excellent chemical quality of hot metal and blast furnace slag. The data are related to a sinter plant with 190m<sup>2</sup> and a blast furnace with 4,237m<sup>3</sup> (inner volume).



**Figure 11 - Sinter Plant – Annual Average Operational Data from 2000 to 2008.**

- High level of sinter productivity with low specific consumption of carbon.
- Low alumina values can guarantee better sinter metallurgical properties (RDI).

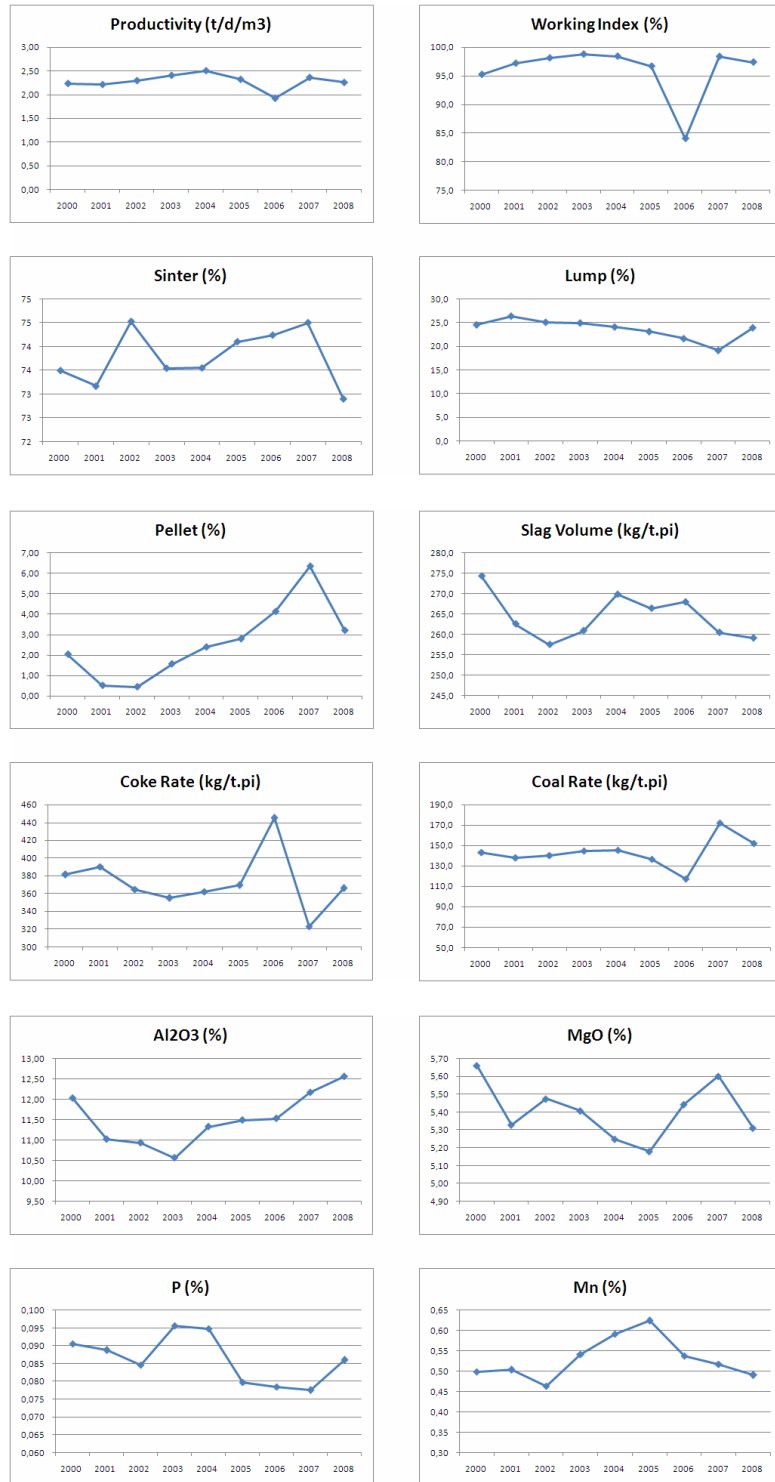


Figure 12 - Blast Furnace – Annual Average Operational Data from 2000 to 2008

- High Blast furnace productivity with 75 ~ 80% of elaborated burden (sinter + pellet).
- The lower productivity in 2006 has been caused by an operational accident.
- Low slag volume values with high consumption of coal.

- Lower (Al<sub>2</sub>O<sub>3</sub>) and [P] values coming from the consumption of CdP Iron Ore Products.
- All the [Mn] required also comes from CdP iron ore products.

## **6 CONCLUSIONS**

The steel market will recover its increasing demand in the next years and for this reason also the iron ore supply demand. CSN through its resource minerals, CdP and NAMISA (60%), is able to answer such supplying increasing with high grade sinter and pellet feeds, lump ore and in a brief future also pellets with a integrated logistic system.

The performance of these iron ore products is witnessed by the excellent operational data presented by CSN's sinter and blast furnace plants.