"TECHNO-OPERATIONAL ASPECTS AND BASIC PHILOSOPHY OF CST TO DEFINE ITS BLAST FURNACES FERROUS BURDEN" [1]

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SUMMARY

This paper describes the main aspects related to the iron ore supply to CST (Companhia Siderúrgica de Tubarão) blast furnace taking into consideration aspects such as CST's strategies and logistics, operational flexibility needs, chemical and physical characteristics of iron ores (fines, lump ore and pellets) and cost competitiveness, showing main operational results.

After studies and projections based on different scenarios have been made, CST has opted to establish a long term exclusivity contract of iron ore supply with CVRD (Companhia Vale do Rio Doce) in order to meet its pig iron and steel production master plan's target of continuous increasing.

Key words: blast furnace burden, sinter, pellet,

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1- INTRODUCTION

In 1996, CST (Companhia Siderúrgica de Tubarão – Brazil) requested to CVRD (Companhia Vale do Rio Doce) the study of availability of lump iron ore for next decade considering the implementation of Blast furnace #2 in July 1998 and others consumption at Brazilian blast furnaces located in southeast region.

This study has demonstrated that there will be steady decreasing of lump ore production from 2002 because exhaustion of some mines in operation and reduction of reserves at others Brazilian mines. And other hand it was forecasted increment of demand due to iron and steel expansion projects in several steels mills using Blast furnace route or Direct reduction route. In figure 1 is showed the forecast of offer and demand of lump iron ore at Brazilian southeast region.

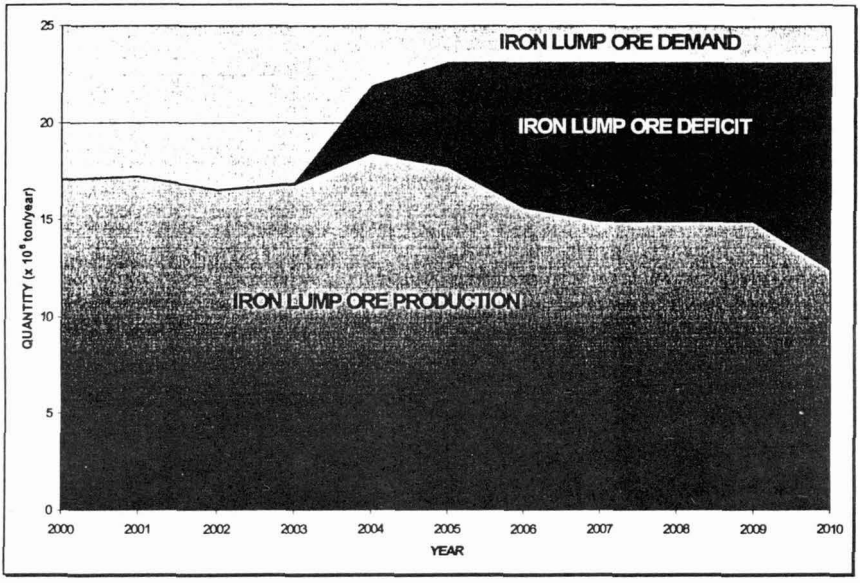

Figure 1: Trend graphic for Lump ore production and consumption

At the end of 1997, CST had the challenge to supply ferrous burden for two Blast furnaces in face to shortage of lump ore forecasted to next decade and needed increment of Sinter production, considering that the Sinter machine width extension project was introduced in August 1997. When occurred lack of lump ore, there would be deficit of Sinter although the Sintering plant operated at maximum capacity.

In figure 2 is shown the relation between pig-iron production and percentage of sinter in ferrous burden, considering that the maximum Sinter production after modernization and pallet widening become 18,400 ton/day.

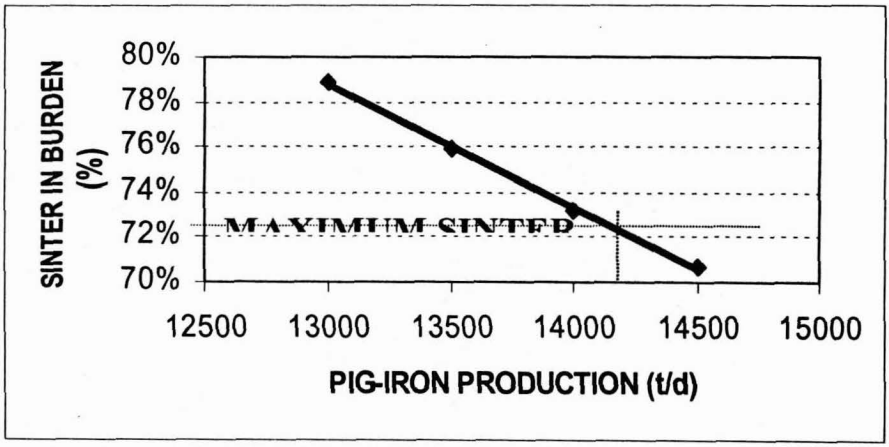

Figure 2: Pig Iron production versus Sinter in ferrous burden at maximum capacity of Sintering plant

The estimate flat pig iron production with two blast furnaces was around 13,500 to 14,300 t/d and availability of lump ore around 10 to 15% in composition of ferrous burden. Therefore, there would be a deficit about 10 to 15% of ferrous burden.

Alternatives to assure ferrous burden supply to Blast furnaces of CST at medium and long term were:

- Increasing of Sinter production capacity by introduction of enlargement project,
- Erection of new Sinter plant
- Introduction of pellets

2 – Change of ferrous burden

These three alternatives were evaluated and the last one, introduction of pellets, was chosen together CVRD, motivated by follow consideration:

2.1 - Technical consideration:

- The ferrous burden of Blast furnaces to be practiced in long term would be 90% of prepared charge (Sinter + Pellets) plus 10% of lump ore, due to decreasing of lump ore availability and increment of pig iron production;
- The pellet would allow the decreasing of Slag volume when substitute Sinter, because the gangue content at Pellet is small than Sinter, see Table 1. This fact would facilitate the increment of pulverized coal injection ;
- The partial substitution of Sinter and Lump ore by Pellet would permit the reduction of phosphorus content in pig-iron, 0,085% to 0,065%, increasing productivity of Steelmaking shop;
- Elongation of life time of Sintering plant parts, mainly many equipment that there are strong abrasion.

Material	FeT	SiO_2	Al_2O_3	CaO	P
Sinter	57,60	5,20	1,25	9,05	0,036
Pellet	65,85	2,05	0,53	2,55	0,028
Lump Ore	66,05	1,55	1,35	0,04	0,055

Table 1: Ferrous burden, chemical composition

2.2 - Strategic and economical consideration:

- Near location between CST and CVRD peletizing plants and CVRD Tubarão Port;
- Minimization of investment cost at Sintering plant, raw material receiving system and yards;
- Possibility to minimize raw materials stocks
- Assuring pellets supply from CVRD, it would be possible choose better investment on steel products;
- Get more stable and smooth Blast furnace operation, aiming to achieve long life campaign

2.3 - Decision of CST to have exclusive supply from CVRD

Beyond the technical and strategic & economical consideration mentioned above, it was considered follow items to have exclusive supply of iron ores and pellets from CVRD:

- CVRD has huge mineral reserve with quality and quantity that suit well for present and future needs and demands;
- Since start-up of CST (1983), CVRD has been the major supplier of iron ore with high liability;

- CST has adopted policy to have strong partnership among its suppliers that had offered good service and synergies.
- Development of partnership with suppliers that aim CST to minimize investment cost for production and stocks, share development and research of new products and application of materials;
- Supplier that have high flexibility to adequate the mix of iron ores to adjust for different economical scenarios, like high productivity, low demand, high quality, etc.
- The market-share of CVRD at CST already was 90% for iron ore fine and 60% for lump ore.
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3 - Main Results

3-1 Sintering Plant

After introduction of pellets in Blast furnace burden, the productivity of Sintering plant was adjusted to the Sinter demand, decreasing its productivity. Simultaneously, it has been changed the raw material mix for Sintering, adjusting burnt lime fine consumption in balance with own Lime Kiln fine generation and introduction of more fine and cheaper iron ores. It has been possible to optimize raw material mix, achieving good quality, decreasing SiO_2 level of Sinter at very interesting cost.

3-2 Blast furnaces operation

The consumption of Pellet at Blast furnaces started in August 1998, using 5% of ferrous burden. Gradually it was increased until 10% in February 1999. See figures 3 and 4. After evaluation of process condition it was achieved 15% in April 1999 and finally 25% in August 1999. This last phase was considered good and CST started to study the long term contract with CVRD.

The long term contract started in January 2000 and has been keeping 25% of pellets in two blast furnaces. The amount of prepared burden has kept at minimum 80% and when have more demand for pig iron production it has been possible increase Sinter production, because with 25% of pellet in both Blast furnaces, it is possible to get until 90% of agglomerated burden without big modification at sintering plant raw mix. This situation has brought a good operational flexibility to define ferrous burden even considering the shortage of lump ore in near future.

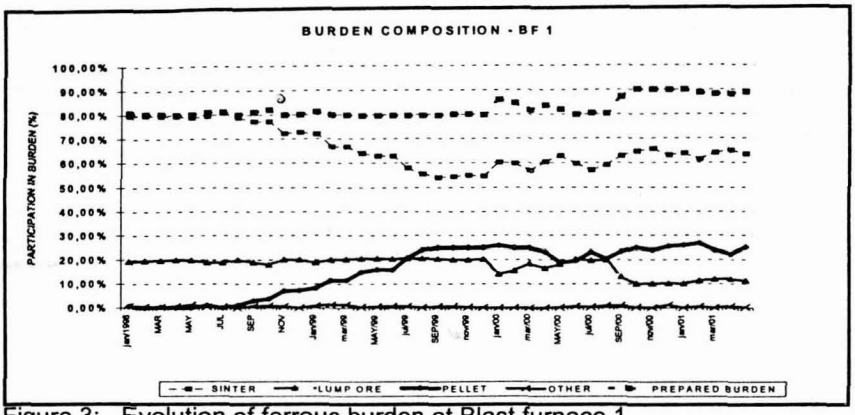

Figure 3: Evolution of ferrous burden at Blast furnace 1

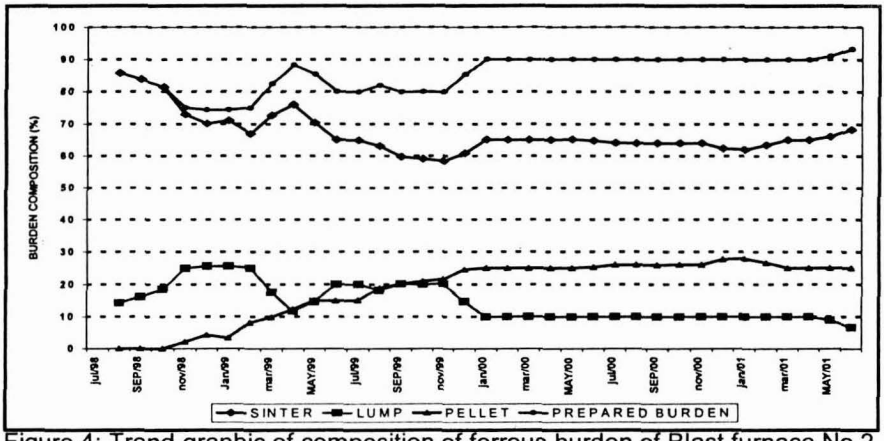

Figure 4: Trend graphic of composition of ferrous burden of Blast furnace No 2

On figure 5 and 6 are shown trend graphics of Slag volume and pellet participation at Blast furnace number 1 and number 2, respectively.

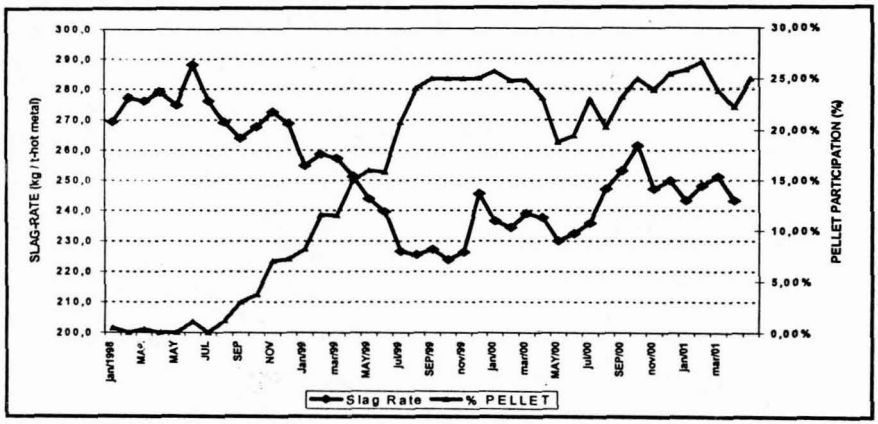

Figure 5: Evolution of Slag-rate and pellet participation at BF 1

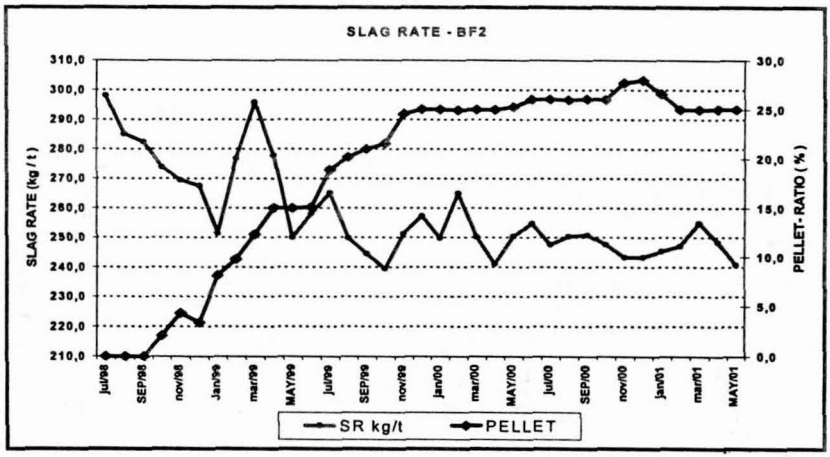

Figure 6: Slag-rate and Pellet participation trend graphic at BF2

The reduction of slag volume has contributed enormously to decrease and stabilize fuel consumption as well to keep high productivity and very stable operation. As shown on figures 7 and 8, the both furnaces have kept good results comparable to the benchmark figures in the world.

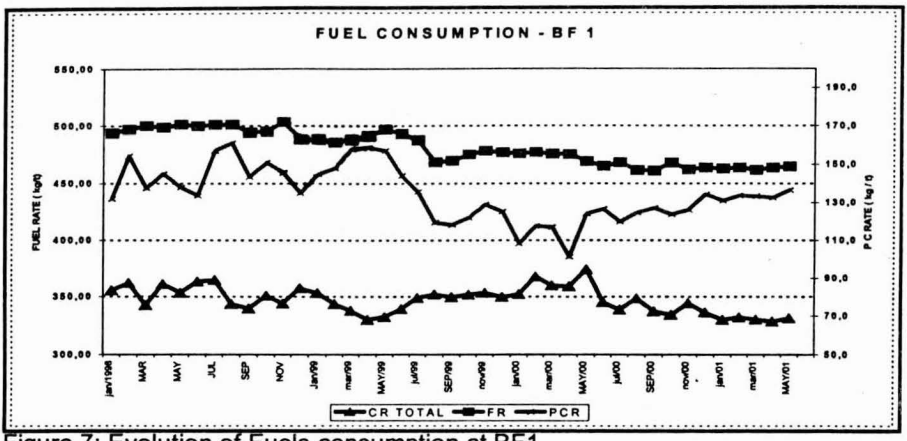

Figure 7: Evolution of Fuels consumption at BF1.

At Blast furnace 1, it was decreased the total fuel rate from 500 kg/t to 470kg/t and total Coke rate from 355kg/t to 335kg/t, keeping productivity around 2,32 t/d/m³, expressing productivity based on total inner volume.

At Blast furnace 2, the total fuel rate decreased from 500kg/t to 470kg/t, keeping productivity of 2,6 t/d/m³, injecting around 190kg/t of pulverized coal.

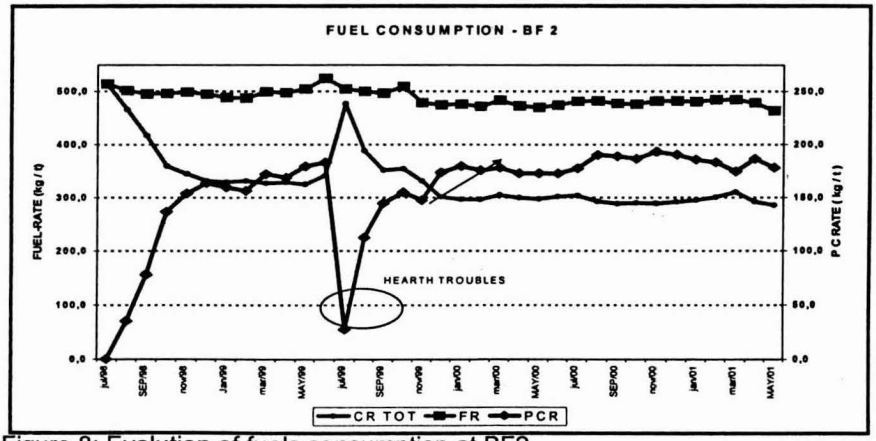

Figure 8: Evolution of fuels consumption at BF2

4 – Future Outlook

The good and stable results of Blast furnaces, operating with all primary iron source from CVRD has given to CST a great liability to keep this philosophy for the future, considering CVRD not only good supplier of iron source, but a excellent partner that help and contribute for development and improvement of quality , productivity and cost efficiency.
CST is studying its expansion plan to increase production capacity of final product to 7.5 million ton per year, installing Blast furnace number 3, but without any investment at Sintering plant. There will be a direct supplying of pellets from CVRD's pelletizing plant by belt conveyors to all three Blast furnaces.
The composition of ferrous burden it will be approximately 50% Sinter, 40% Pellet and 10% Lump Ore, with Slag-ratio less than 200 kg/t. It is expected to get high productivity, high pulverized coal injection rate and very stable operation.

5 - Conclusion

Considering the cost composition of final steel product, the ironmaking area has contributed significantly, mainly due to coal for coke oven and injection into Blast furnaces and many kind of ferrous burden.
The minimization of pig iron cost means to get very stable and high productivity operation using good raw materials.
CST changed his method to acquire ferrous source, not seeing only price of each material, but considering optimization of whole process related to pig iron process, including own sintering plant, pellet, lump ore, fuel and reductant consumption.
The partnership got with CVRD has shown that is has been a good solution to stabilize blast-furnaces operation with very competitive cost. The most important goal is not only to assure supplying ferrous source with specification in accordance with needs of consumer, keeping quality and volume. The main point has been the relationship and partnership between supplier and customer, and the supplier working continuously to solve problems and challenges of client, searching the best ways.