Excellence in Energy Conservation and Management

2003-04

STEEL AUTHORITY OF INDIA LIMITED
BOKARO STEEL PLANT

Brief write up on Projects implemented in 2003-04

A) Commissioning of walking beam type reheating furnace

Background :

As per DPR , HSM was provided with 4 nos. of pusher type reheating furnaces of capacity 250 T. Each pusher type furnace was provided 59 nos. injecting type burners distributed in 5 zones. Mixed gas (a mixture of BF gas and CO gas) of CV 1650 Kcal/nm3 at a pressure 2000 mmwc was used as input fuel. This pusher type furnace has following limitations.

1. High sp. heat consumption due to

- Low turn down ratio of burners resulting in high fuel consumption during delays.
- Low thermal efficiency.
- Lower rate of production.

2. Low quality of output coil due to non-uniform heating and presence of skid marks.

Modification :

In order to reduce the sp. heat consumption of these furnaces and to improve quality, technological up gradation programme of replacing existing pusher type furnaces with walking beam type furnace was undertaken. The first walking beam furnace was commissioned in 98-99. The 3rd pusher type furnace was replaced in 00-01. **The pusher type Furnace no. 2 was replaced with walking beam type and commissioned in May'03.**

Technical & Financial analysis :

a) Avg. sp. heat of furnace 2 before modification :0.852 Gcal/T slab rolled.
b) Avg. sp. heat of furnace 2 after conversion to walking beam furnace
(June'03 to Mar'04) : 0.326 Gcal/T slab rolled.
c) Investment for conversion : 5800 lakhs.
d) Savings from sp. heat only : 204.5 lakhs /month
e) Simple pay back period due to reduction of sp. heat: 29 months

B) Installation of Multi Slit Burner system in Sintering Plant

Introduction

In sinter band no.1, multislit burner system was installed in Aug'2003 by replacing existing twin hearth system, using mixed gas and coke oven gas respectively. In the existing system, 12 nos. mixed gas burners are mounted on top of 1st hearth where mixed gas of calorific value 1450 kcal/nm3 is used. In 2nd hearth, only CO gas is used by 6 side burners. After installation of multislit burners, CO gas firing has been stopped and mixed gas of CV 1600 – 1650 kcal/nm3 is used in 1st hearth through specially designed multislit burners.

Special features of the burners are :

- There are 32 top mounted burners in a single row across the bed.
- It gives short and intense flame, which ignite top layer by direct heating.
- It ensures uniform heating
- It provides faster heat transfer.
- There are two pilot burners on either side used during M/C stoppage

Experimental data shows that :

Sp. heat consumption in band no.1 was reduced by 65% compared to band 2 & 3 due to 90% reduction of furnace volume.
Consumption of +40 mm fraction has reduced from 28 % to 18%.
Productivity has increased by 5 % from 1.13 to 1.185 t/m2/hr due to 9 meter increase in sinter bed length.

Refractory and maintenance cost have reduced due to reduction in furnace volume from Rs. 13.5 lakhs to Rs. 4.00 lakhs during each capital repair.

Technical & Financial analysis :

a)Avg. sp. heat of band 1 before modification :0.041 Gcal/T gr. sinter.
b)Avg. sp. heat of band 1 after comm. of multislit burners (Aug'03):0.020 Gcal/T slab rolled.
c)Investment for conversion: 16 lakhs.
d) Savings from sp. heat only : 13.8 lakhs /month
e) Simple pay back period :1.2 months (36 days)

C) Improvement in thermal efficiency of batch annealing furnaces at Cold Rolling Mill

Background :

Cold rolling of Hot Rolled coils is done to produce thinner gauge strip of very smooth and dense surface with better mechanical properties than hot rolled strips. Rolling is done at room temperature ie without heating the material. In thickness reduction process, the gain structure of steel is elongated and heavy internal stress is developed. In order to relieve the stress of the steel, annealing is done by heating the coil to a temperature about 680 ^{0}C to 720 ^{0}C and then gradual cooling to room temperature. The annealing is done in batch type hood annealing furnaces and in continuous annealing furnaces.

There are 235 no. of bases and 107 no. of hood furnaces. The hood annealing furnaces in Annealing I are provided with injecting type of burners where combustion air is sucked at burner mouth due to high pressure of mixed gas (2000 mmwc). The furnaces are provided with arch type roofs and fire clay bricks are used for insulation. In order to improve the thermal efficiency, experiment was done to use ceramic fiber insulation in place of fire clay bricks and arch type roofs were modified to flat roof to accommodate more coils. Experiment shows that sp. heat consumption of modified furnace has reduced by 17 %.

Action :

Replacement of fire clay brick by ceramic fibers and change of arch type roof to flat roof of batch Annealing furnaces in phases. Modifications carried out in last three years are:

2001-02	5	Annealing furnaces
2002-03	4	Annealing furnaces.
2003-04	17	Annealing furnaces.

Technical & financial analysis :

Cost of Modification : 2.4 lakhs per furnace
Rate of thermal energy (Gcal) saved in last 3 years: 318.5 Gcal/month
Average savings (Rs) : 0.11 lakhs/month /furnace
Simple pay back per : 22 months

D) Commissioning of duplex burner in kilns of Refractory material Plant

Background :

With modernization of Plant i.e. after commissioning of thermally efficient walking beam furnaces at Hot Strip Mill and partial phasing out of soaking pits , the plant has surplus of

byproduct gases. There is no provision to supply and use by product gases in Captive Power Plant. For improved gas management, it was planned to use surplus coke oven gas in Refractory Material Plant to replace tar/PCM partially which is used for calcinations of Lime stone. The PCM (Pitch creosote mixture) thus saved was supplied to power plant through a separate line to generate power. The surplus PCM was supplied through a separate line laid between By Product Plant and Power plant .

Action :

In order to use CO gas in Refractory Material Plant , ***duplex burners*** (Capable of firing both PCM and CO gas) have been fabricated in house and installed in kiln no. 1,2,3,4 & 5 to use surplus CO gas.

Technical & Financial analysis :

Expenditure for fabrication of one duplex type burner.

Blower: Rs. 40,000=00
Motor : Rs. 54,000=00
Fabrication & others: Rs. 35,000=00
Total Expenditure : Rs. 129,000=00 per kiln
No. of kiln modified : 5 nos.
Expenditure for 5 kilns : 6.4 lakh
Cost of laying separate line: 113.00 lakhs
Total expenditure including line : 119.45 lakhs
Net savings from additional Power generation at CPP by the use of PCM: 20 lakhs / month

E) Rebuilding of Battery 7

Background:

Battery no. 7 was first commissioned on Feb'83. In course of operation, due to ageing, the efficiency of battery reduced substantially. The yield of byproducts viz. CO gas & crude tar observed to be lower as compared to target whereas sp. heat and power consumption were higher. The production was less due to undercharging of coal in the battery. This was mainly due to poor health of individual ovens along with refractories. It was felt necessary to rebuild the battery no. 7.

Rebuilding

In order to improve the efficiency of battery, it was planned to rebuild the battery. Accordingly, the batter no. 7 was taken down for rebuilding on 98-97. It was recommissioned after rebuilding on Jan'03. Investment made to rebuild the Battery was 30 crores

Techno-economics

The status of Energy parameters before and after is shown below:

Sl.no	Energy parameters	Unit	Status	
			Before (98-99)	After (02-03)
1.0	Dry coal charge per oven	T	19.6	20.64

2.0	Sp. heat consumption	Gcal/T dry coal	0.613	0.594
3.0	Sp. Power consumption	Kwh/T of gross coke	30.8	27.3
4.0	Crude tar yield	Kg/T of dry coal	26.4	30.6
5.0	CO gas yield	Nm3/T of dry coal	306.4	318.2
6.0	Net Energy consumption	Gcal/T gross coke	1.356	1.291

Energy savings : 32135 Gcal in 03-04
Cost of energy : Rs 519/Gcal
Financial gain due to lower energy consumption: Rs 167 lakhs/ year
Saving due to increase in prodn. of gross coke : Rs 736 lakhs / year
Total savings : 736 + 167 = 903 lakhs / year : Rs 75.2 lakhs / month
Expenditure : 30 crores
Pay back period : 40 months

F) Monitoring and liquidation of utility leakages through 'DIAL 100'

A dedicated phone (phone no. 100 of plant intercom) has been installed at energy center to receive complaint regarding any leakages in utility line viz steam, water, oxygen, fuel gas and air. Any employee inside the plant can dial 100 (max) and give information regarding the utility type, nature and location of the leakage. The message is recorded round the clock by shift in charge of Energy Management department (EMD). Emergency leakages are intimated immediately to concerned HODs' for immediate action. All other complaints are scrutinized in the early hours of general shift by an officer of Energy Management Department and informs HODs' of power plant, oxygen plant, water supply and ACVS department respectively for rectification of leakages in steam, oxygen, water , gas and compressed air lines respectively. A comprehensive report on status of rectification is monitored in weekly review meeting with ED (W). The format for monitoring and liquidation of utility leakages is shown below.

No. of utility leakages rectified since 15.09.03 :

Compressed air : 3
Steam : 27
Water : 43
Financial savings works out to be : 30 lakhs in 03-04

BRIEF WRITE UP ON BOKARO STEEL PLANT

COMPANY PROFILE

Bokaro Steel Plant, one of India's largest flat steel producer in the public sector is designed to produce flat products like Hot rolled Coils / Plates / Sheets, Cold rolled coils / sheets, Tin Mill Black Plates and Galvanised Plain / Corrugated Sheets (GP / GC). Bokaro's world class hot rolled products enjoy excellent acceptance in the international market.

With a saleable steel production capacity of 3.78 million tones, the plant has been recently modernized with continuous casting facilities and a state-of-the-art Hot strip mill for producing quality steels of international standards. A range of special steel products like DMR 249A, E-460/500/550, IS-8500 Fe540B, SAILCOR, SAILPROP, SAILMEDSi, SAILRIM, API grade steel, HRNO, SAILMA, WTCR, BSL-46 for auto sector etc. have been introduced after modernization. All the units of the plant from steel making to the finished product are accredited to ISO:9002 Quality Assurance systems.

ENERGY CONSUMPTION

Steel industry being highly energy intensive in nature is one of the major consumers of energy. Energy accounts for nearly one third the cost of production of steel. About 70% of the energy consumption is upto iron making stage.

Energy consumption of a steel plant depends upon various factors such as:

- ✧ Process route & level of technology
- ✧ Type of finished products
- ✧ Quality of raw materials and other local conditions
- ✧ Level of automation & computerization schemes in the plant.
- ✧ Level of energy conservation and recovery systems.

The basic energy input (purchased) to the steel plant are

- ✧ Coking coal (both low ash imported coal and indigenous) for producing coke used in Blast Furnace for Iron making.
- ✧ Coal for injection in Blast furnace
- ✧ Power.
- ✧ Diesel for mobile equipments

The basic energy input (purchased) to the steel plant and their contribution to energy bill with respect to cost of production is given in following table.

SN	Parameters	Unit	01-02	02-03	03-04
1.0	Consumption of basic energy				
1.1	Metallurgical coal.	Kg/T of crude steel	1048.7	1051.6	1043.4
1.2	Coal for injection in Blast furnace	Kg/T of hot metal	13.0	11.3	14.2
1.4	Purchase Power	Kwh/T of crude steel	231.6	556.6	536.4
1.6	Total Energy Bill.	Rs. in crores	1588.01	1896.0	1948.02
2.0	Total Manufacturing cost	- do -	5280.67	5039.4	5381.43
3.0	***Contribution of Energy bill over production cost .***	***%***	***30.1***	***37.6***	***36.2***

ENERGY CONSERVATION COMMITMENT , POLICY & SET UP

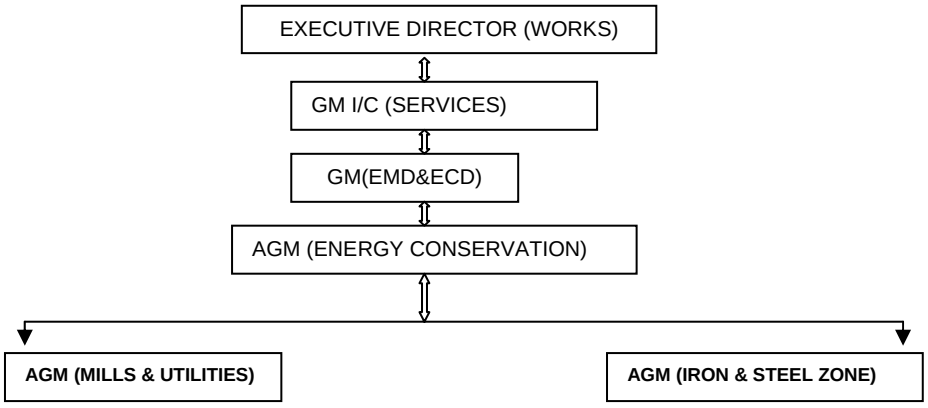
Energy Management Department of Bokaro Steel Plant is committed to monitor and conserve Energy at each stage in steel making with full support from the top management. Various projects, programs and workshops are carried out to conserve and optimize energy consumption under guidance and encouragement from top management. Emphasis is laid on reduction of energy cost by optimizing the energy mix, reducing consumption of costly basic energy and sale of value added Coke oven by products.

Bokaro Steel has established a well organized Energy Management Department since inception for sustained and systematic approach towards efficient utilization of energy.

A separate energy conservation cell comprising 6 executives, 26 skilled and 11 semi skilled workers is operating under Energy Management department for monitoring and controlling all energy parameters in close association with all units of the plant.

The energy cell is headed by Assist. General Manager exclusively for monitoring energy consumption of the plant.

The structure of the energy cell is given below.



Energy schemes completed in 2003-04

- Rebuilding and commissioning of coke oven battery no.7 with HPAL system.
- Stoppage of coke oven gas consumption in 2nd hearth of Sinter band no. 2 & 3.
- Use of mixed gas in stoves of Blast furnace no. 2,4 & 5.
- Capital repair with introduction of stainless steel sheet in combustion chamber of stove no. 2 of BF no. 3 and Medium repair of one stove (stove no. 4) of BF no. 2.
- Commissioning of duplex type (capable of firing both PCM and CO gas) burner in kiln no. 5 at Ref. Material plant.
- Capital repair of 3 nos. soaking pits and 2 nos. of recuperators in Slabbing Mill.
- Commissioning of 3rd. walking beam type reheating furnace.
- Introduction of 4 nos. new inner covers in hood annealing furnaces at Cold Rolling Mill.
- Introduction of flat roof with ceramic fiber lining in 17 annealing furnaces in Cold Rolling Mill.
- Repair of 105 nos. base fans in Annealing Furnaces of Cold Rolling Mill.

ENERGY CONSERVATION ACHIEVEMENTS

As a result of the above energy conservation measures taken and optimization of the operating & maintenance practices, there was a marked improvement in all the major energy parameters. The % improvement of the major energy indices as against 01-02 is shown below :

The status of energy parameters and % improvement over 01-02

Sl. No	Parameters	Unit	Year			% impro-vement over 01-02
			2001-02	2002-03	2003-04	
1.0	Sp. Heat consumption					
	- Coke Oven	Gcal/T dry coal	0.600	0.595	0.594	1.0
	- Sinter Plant	Gcal/T gross sinter	0.051	0.044	0.033	35.3
	- Blast Furnace	Gcal/T hot metal	0.601	0.588	0.585	2.7
	- Hot Strip Mill	Gcal/T slab rolled	0.484	0.469	0.442	8.7
	- Cold Rolling Mill	Gcal/T annealed coil	0.357	0.350	0.336	5.9
2.0	Sp. Power Consumption					
	- Coke Oven	Kwh/t gross coke	29.9	27.6	27.3	8.7
	- Sinter Plant	Kwh/T gross sinter	50.4	49.0	46.7	7.4
	- Steel Melting shop	Kwh/T crude steel	33.8	36.0	29.5	12.7
	- Slabbing Mill	Kwh/T slab	34.7	31.2	32.2	7.2
	- Cold Rolling Mill	Kwh/T CR Product	164.6	164.7	154.1	6.4
3.0	Coke Rate	Kg/T hot metal	549	536	541	1.5
4.0	Coke Oven Gas yield	Nm3/T dry coal	313.9	317.3	318.2	1.4
5.0	Crude Tar Yield	Kg/T dry coal	30.2	30.4	30.6	1.3
6.0	Overall Energy Consumption	Gcal/T of crude steel	7.480	7.360	7.338	1.9

Awards on Energy Conservation:

- ✧ **Bokaro Steel Plant has won the National Award for excellence in Energy Management 2003 by CII (Southern Region) as an Energy Efficient Unit.**

- ✧ **Bokaro Steel Plant won the first position in the Energy Conservation contest for 2003-04 cy CII (Eastern Region).**

ENERGY CONSERVATION PLANS AND TARGETS

Future energy conservation plan for the year 2003-04 are :

- Coal dust injection in 2nd Blast Furnace.
- Installation of multislit burners in band 2 & 3 of Sintering Plant.
- Moderisation BF gas bleeder system with state of art control system and provision for operation of throttles at strategic position for efficient distribution of fuel gases and minimization of bleeding losses.
- Computerized energy management system for optimal use of various forms of energy.
- Commissioning of coal tar injection system in Blast furnace # 1 to replace coke.
- Oxygen enrichment in Blast furnace # 5
- Cast house slag granulation plant.

The target for Energy consumption for 2004-05 is 7.300 Gcal/Tcs

SAFETY

Health and safety have been accorded top most priority in BSL. A full fledged Safety Engineering Department headed by General Manager (Safety, fire) is operating in the plant to inspect, monitor and ensure implementation of safe working of various plant units with trained safety officer. Regular medical check up of employees is being done.

A separate gas safety section working under energy management department provide gas safety assistance to all gas hazardous jobs. Round the clock monitoring of safe working is done during capital repair, shutdown and special repair jobs.

5 Star Health & Safety Management System was first introduced in the year 96-97 and spread within the various units of plant. It has been implemented in Battery 1 & 2 , Benzol recovery plant and desulphurisation unit of Energy management department in the year 1999, Steel Melting Shop no.

1(Pit Side) in 2000 , Slabbing Mill (soaking Pit area) in 2001 and Blast furnace Gas cleaning plant no 3 &4 in 2002.

Designated departmental safety officers(DSO) of all the departments are made responsible for monitoring the safety activities in the dept. who also co-ordinates with safety Engineering Dept. in various activities linked to safe working.

Bokaro Steel Plant has bagged Steel Minister's trophy and SAIL chairman's trophy for best safety performance.

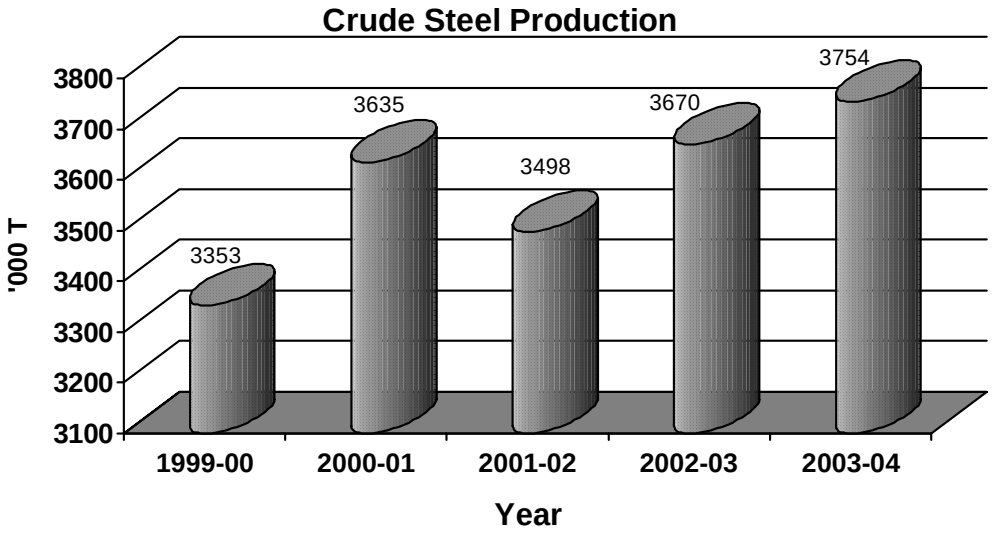
ENVIRONMENT MANAGEMENT

Bokaro Steel Plant has been provided with the latest environmental protection system as regards to air, water, noise and solid waste pollution with state of art laboratory functioning round the clock. The performance highlights for the year 03-04 in Bokaro Steel Plant are as :

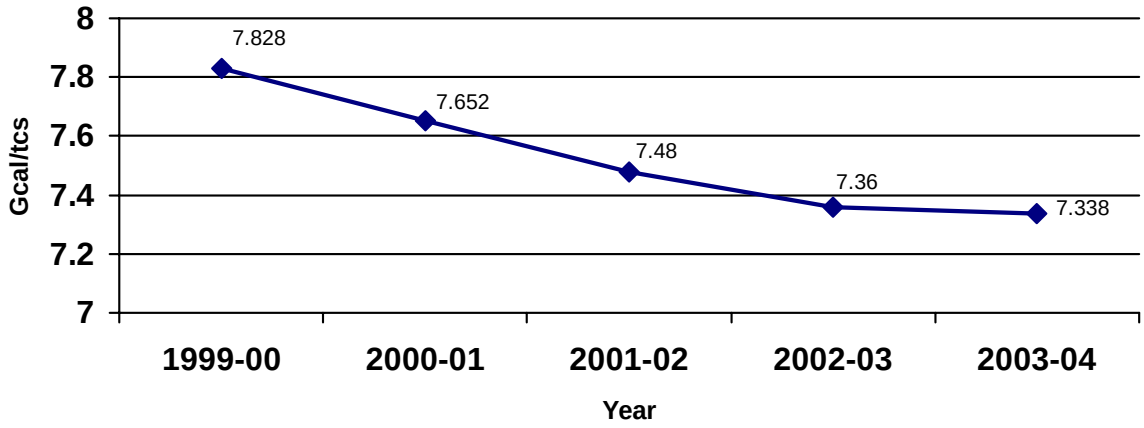
- Effluent discharges from all three outlets of the plant are maintained within the stipulated norm.
- Emissions from all the stacks except from Sinter exhaust are within stipulated norms.
- Ambient air quality in & around the township remained within the stipulated norm.
- 100% use of processed LD slag as rail ballast for Internal Railway Track replacing stone ballast.
- Used 82286 T of LD slag dust in Sinter plant replacing equal amount of flux.
- 24333 T of LD Slag chips of size 10-40 mm charged directly into Blast Furnaces.
- Use of 48045 T of LD Slag chips of size 10-40 mm directly in SMS convertor.
- 33292 T of LD Slag chips of size 10-40 mm supplied to IISCO.
- Use of 17250 T of LD Slag chips through CED & Township for road repair.
- Fugitive emission from Coke oven batteries have been reduced. PLD, PLL & PLO in Battery no. 3 & 7 are well below the stipulated norm.
- Water consumption has been reduced to 8.8 Cu. M /T crude steel.

Bokaro Steel Plant has been adjudged the best Steel Plant in Metal sector and given environmental excellence Gold award by "Greentech Foundation ", New Delhi.

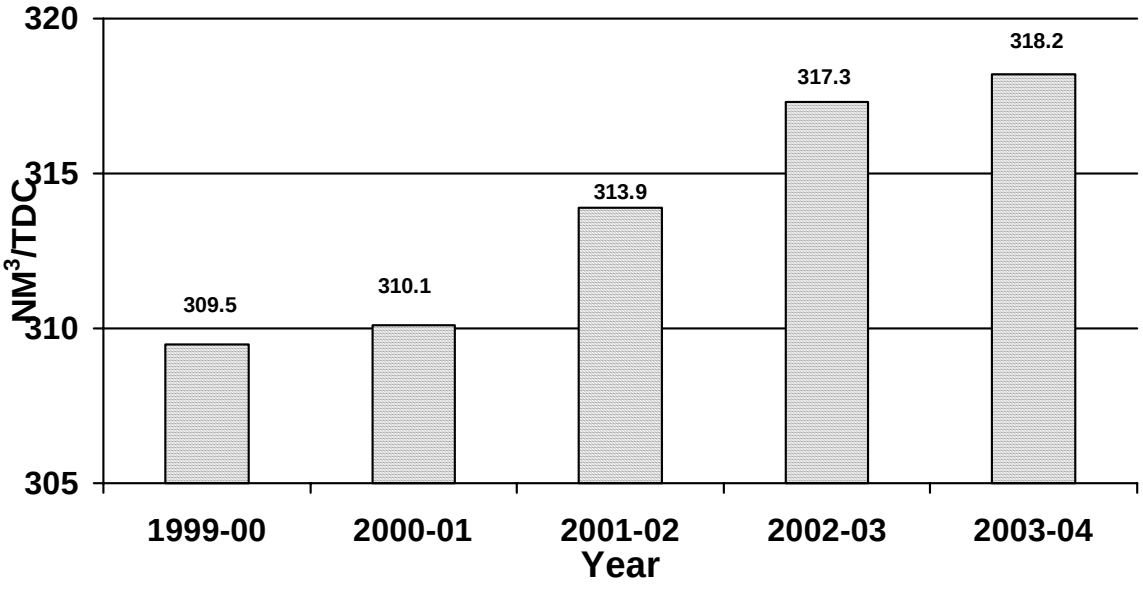
The gradual improvement in all major energy parameters over last 5 yrs is depicted in the graphs attached.



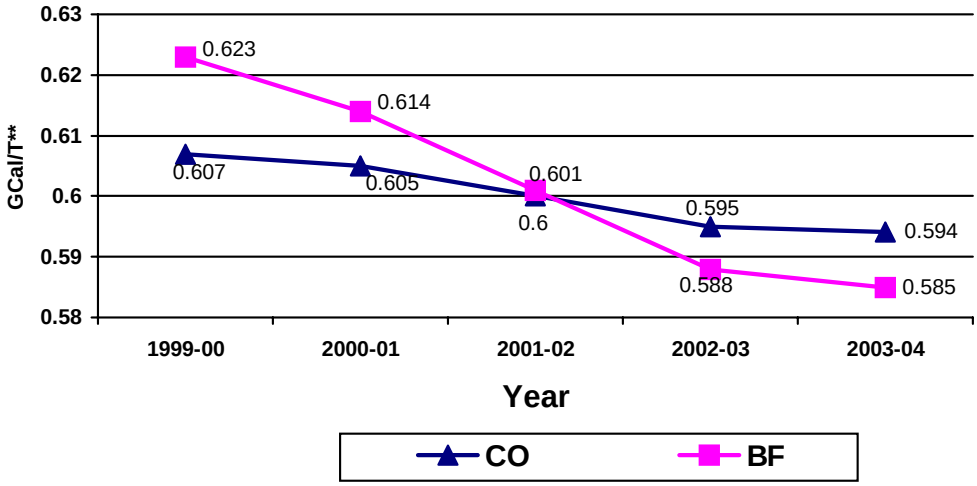
Specific Energy Consumption



Coke Oven Gas Yield

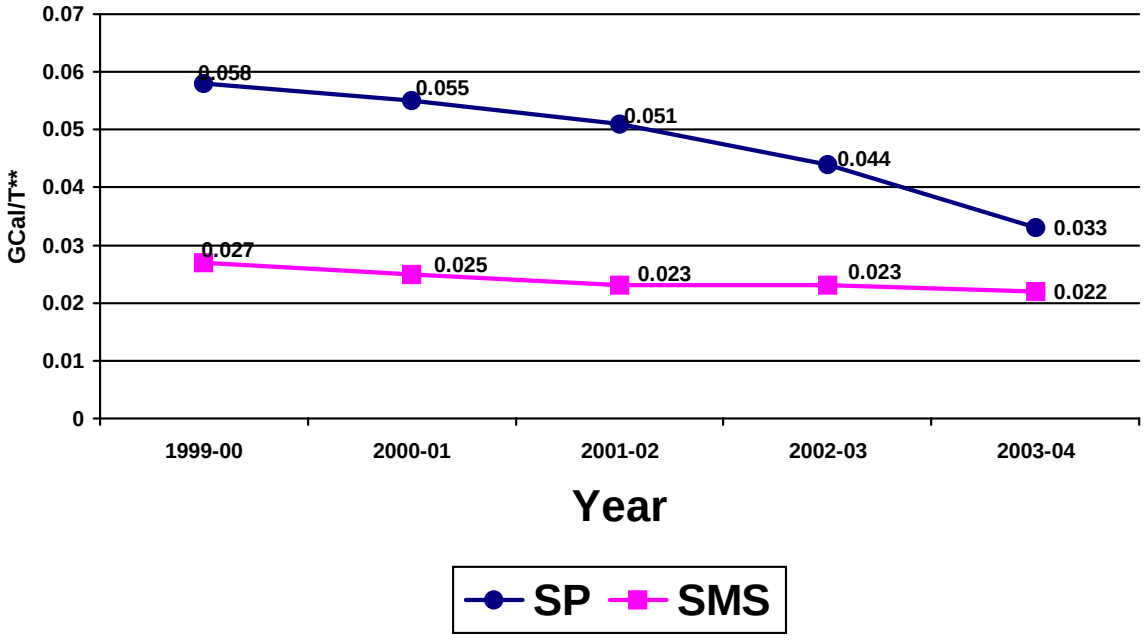


Sp. heat consumption in Coke Oven & Blast Furnace



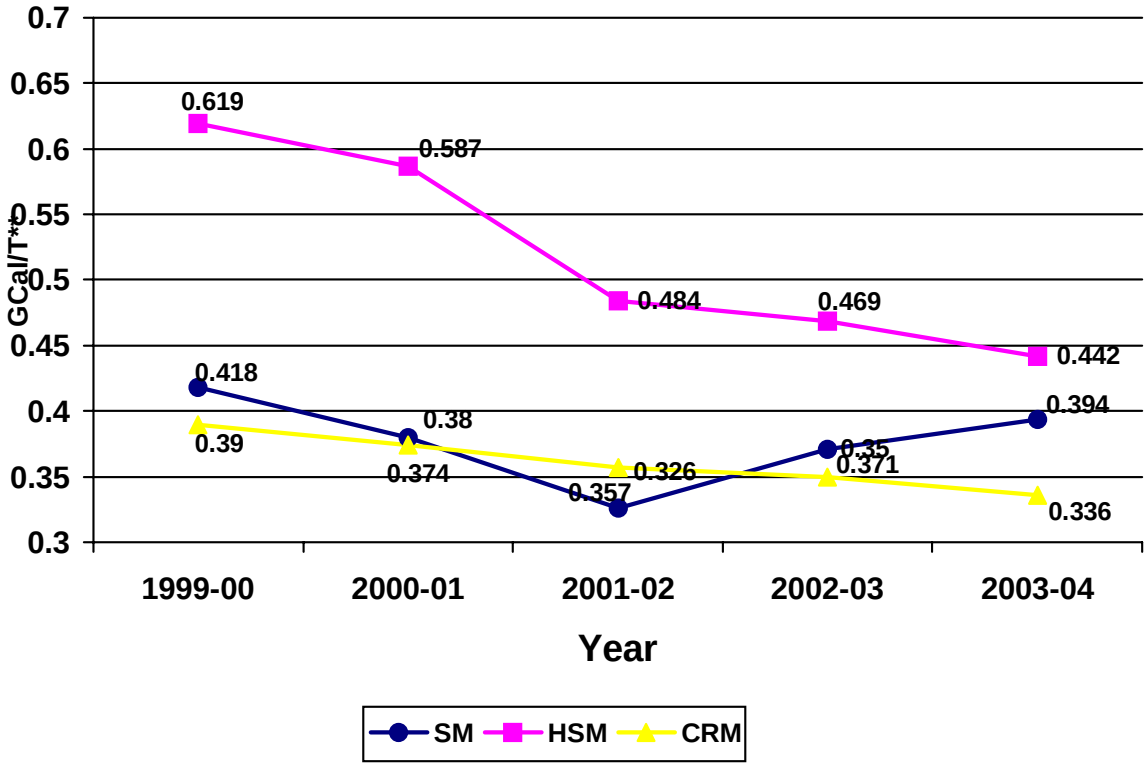
** CO – GCal / Tonne dry coal BF – GCal/ Tonne Hot Metal

Sp. heat consumption in Sinter Plant & Steel Melting Shop



** SP – GCal / Tonne of Gross Sinter SMS – GCal / Tonne of Crude Steel

Sp. heat consm. in Slabbing Mill, Hot Strip Mill & Cold Rolling Mill



** SM – GCal/Tonne ingot rolled HSM – GCal/Tonne Slab rolled CRM – GCal/Tonne Annealed Coil

COKE RATE (KG/THM)