COKE DRY QUENCHING :

CST's CASE (1)

Vander Luiz da Silva (2)
Coletano B. de Abreu Neto (3)
Paulo T. Buaiz Silvares (4)
José Geraldo C. Tardin (5)
José Gilberto Belchior (6)
Carlos Alexandre Tucci (7)

ABSTRACT :

Iniatially a description is presented of the Coke Dry Quenching process, as well as its productivity restrictive variables.

The characteristics of the CST's CDQ plant, equipment performance, achieved operacional results, energy recovery and the environment impacts are presented.

This paper also shows the start-up main problems as well as the alternative solutions adopted.

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(2) Head of Dept., Coke Plant .

(3) Head of Dept., Ironmaking Technical Unit.

(4) Head of Section, CDQ.

(5) CDQ Specialist.

(6) CDQ Specialist.

(7) Coordinator - Coke Plant Development.

1 - INTRODUCTION :

The energy recovery in the productive processes has been an outstanding point to be considered, and studies have been developed by the modern industries, specially by the biggest consuming ones.

As the steelworks are big energy consumers, efforts have been made to reduce the energy consumption and also to make these industries less dependent on external sources.

The Coke Dry Quenching Technique is not new; it has been developed by the Sulzer Brothers in Switzerland in the middle of twentie's and it is actually the starting point for the development of the dry quenching tecnique in the steelmaking process. Since Sulzer Brothers' technique was intermittent, it has limitations in quality and quantity of the steam produced.

A new conception of CDQ, for continuous operation has been developed by the USSR, around 1960, developing the technology, and the first plants were started up in Cherepovetz.

With the high increase of energy costs, the bitter necessity to reduce pollutive sources, as well as the resulting improvement in coke quality, the Coke Dry Quenching process has become of a vital importance for the international steelmaking world.

In the sixtie's, Japan has acquired this technology and has implemented it in many of their plants. Recently in Brazil, in Companhia Siderúrgica de Tubarão - CST, this system has been implemented, and this process is already conquered. In addition , in some aspects, it has been improved by CST own Know-how.

Table 1 shows the distribution of the Coke Dry Quenching plants nowadays in operation.[1]

2 - OBJECTIVE :

. Describe the coke Dry Quenching technology.

. Report the CST's experience in the CDQ plant.

. Show CST's operational results.

3 - PROCESS DESCRIPTION : [2]

The incandescent coke is pushed to a metal bucket with a sliding bottom and placed over a platform which is pulled by an electric locomotive.

The bucket is conducted to the CDQ, where after correct placed is lift by the travelling crane tower to the quenching chamber's top where the coke is unloaded in the charging hole . All the Coke Dry Quenching translations follows a logical synchronism, so that to give operational security and to save time.

The coke, in the quenching chamber (temperature 1000 ºC - 1100 ºC), is brought into counter current contact with inert gas flow and, by this way, it is cooled.

The gas absorbs the coke sensible heat, reaching temperatures between 700 ºC and 800 ºC, then passes in a waste heat boiler where happens the heat transfer with the water, producing steam under certain conditions of temperature and pressure.

After the heat exchange in the boiler, the cooled gas (temperature about 180 ºC) is returned again to the chamber by a fan and it is kept in a closed circuit.

The CDQ plant consists normally of many parts following the lay out priorly chosen with capacities determined by the coke quantity necessary to be quenched. Basically each part has a quenching chamber (divided into prechamber and the cooling chamber itself) discharging device, waste heat boiler, fan for continuous gas circulation, coke dedusting equipment for circulating gas cleaning and dust catching and transporting system. Fig. 01 shows a general flowsheet of the process.

3.1- Prechamber :

Inside the prechamber coke is held for about 1 hour and during this time it is still incandescent, improving its homogeneization and physical quality due to this additional' improved oversoaking process.

The prechamber has the purpose of regulating the coke charging to the cooling chamber, it absorbs the changes in the charging flow,thus allows a continuous discharge of quenching coke and mainly a stable steam generation.

We have to mention that the circulating gas is not brought into contact with the incandescent coke in the prechamber.

3.2- Cooling Chamber :

Inside the cooling chamber itself, coke is slowly cooled down to a suitable temperature for its discharge. This slow dry cooling is the main factor for the increasing of the coke physical characteristics because it reduces deeply the occurrence of macro and micro cracks in the coke lumps which are the main elements for the coke strength and stability improvement.

3.3- Discharge :

The quenched coke is discharged (the temperature about 180 ºC) in the lower part of the chamber in an alternate sequence with pressurized Nitrogen in order to prevent leaks of circulating gas to the atmosphere.

3.4- Auxiliary Equipment:

Between the cooling chamber and the waste heat boiler,there is a dust catcher to remove the circulating gas coarse dust, in order to prevent the rupture of the waste heat boiler next the tubes by the abrasion.

Between the waste heat boiler and the main fan there are two cyclones to remove fine dust in order to prevent the fan blade wear.

All the dust recovered is sent, by means of a pneumatic carrier, to bins where are discharged in trucks for various uses.

The Coke Dry Quenching plants, depending on their characteristics and lay-out can also have auxiliary equipment for the waste heat boiler operation like deairing equipment , chemical addition system, boiler feeding water system, etc.

3.5- Gas Circuit :

The cooling gas, after the main fan, is blown in the bottom of the chamber, passing by a system of central and peripheral distribution in order to allow an uniform cooling through the coke. This gas circulates in counter - current and ascends in the quenching chamber, passing through a collecting split ring, composed by disposed channels of regular shape through out the top chamber perimeter. From the collecting ring the gas pass to the dust catcher, waste heat boiler, cyclones and to the fan, and then blown again into the low part of the chamber, flowing continously in a closed circuit.

The cooling gas circuit is under depression through out the part between chamber's outlet and the fan inlet, so this part has to be airtight, because any air inlet can provoke coke combustion and explosive mixtures. For a safe operation of the Coke Dry Quenching the content of the following elements of the circulating gas are controled: $H_2 \leq 4{,}0$ %; $CO \leq 12{,}0$%; $O_2 \leq 1{,}0$ %; $CO_2 \leq 14{,}0$ %; $N_2 \geq 70{,}0$ %. The plant is also provided with an auxiliary fan for emergency in order to keep continuous cooling gas circulation to prevent explo - sive pockets.

4 - PROCESS PRODUCTIVITY RESTRICTIVE VARIABLES :

Among the main variables that limits the process productivity, the outstanding ones are:

. discharged coke temperature;
. circulating gas specific flow;
. waste heat boiler productivity;
. circulating gas temperature in the waste heat boiler inlet;
. gas distribution in the cooling chamber;
. circulating gas composition.

5 - MAIN ADVANTAGES OF THE COKE DRY QUENCHING :

5.1- Energy Recovery :

From the Table II, where it is shown, for illustrate means, the foreseen heat balance sheet of the CST's Coke Dry Quenching plant, we can observe that foreseen efficiency for the process is around 84,0 %,which is an expressive number, from the point that all this energy is lost, in the conventional quenching.

5.2- Environment Control :

Among the main environment control advantages of the CDQ process we should mention the elimination of the steam generated in the wet quenching which is potencial responsable for the corrosion of metal structures due to chloride and sulfide formation and the elimination of the hydric pollution generated by the CWQ process.

5.3- Improvement on Coke Quality :

Improvement in physical and chemical quality of the produced coke is due to the coke holding time in prechamber to slow its and gradual cooling and to the compression and abrasion suffered by coke down-stream in the cooling chamber.

6 - CST's EXPERIENCE IN CDQ OPERATION :

The CST's CDQ plant consists of five chambers/waste heat boiler wich are independent of each other and the former project has foreseen four chambers in operation and one in stand-by condition.

The plant has two crane towers and two travelling cranes to lift the coke bucket to charge the chambers. The plant was project for the quenching capacity of 1,670 x 10^3 tons of coke per year. The plant basic specifications are shown on Table III.

The plant started up in 07.04.83 and CDQ coke production has already surpassed 5.5 x 10^6 tons. In Table IV, the start-up dates, accumalated production, as well as the shutdown dates of each unit are presented.

After four years of CDQ's operation, CST is already skilled on the process what allows to ensure a secure and stable operation. Practical control models were developed and improved what allowed not only to achieve the originally foreseen operational' results but to improve, in most of the cases, the performance and production capacity of the plant.

During the first semester in operation, some irregularities, that were happening and affected the operation somehow, were overcome. Among the main ones we can mention :

6.1- Premature Refractories wear of the Quenching Chamber:

The life of the quenching chamber refractories was initially foreseen to last between seven and ten years, but in an inspection carried out six months after the start up an excessive refractories wear ocurred suggesting the necessity of a total rebuilt in less than one year. The adopted solution was Gunning at all the affected region, using, for this purpose, a technology of preparation, projection and own hand labor, and today we can assure that refractories ' rebuilt will happen at the foreseen time. As a security decision the quenching chambers refractories specification was changed, as well as the brickwork erection engineering was improved, aiming a better strength, and the refractories ' were developed and made in the brazilian industries.

6.2- Cooling gas Velocity :

Due to the excessive cooling gas velocity at the quenching chamber's top, there was a coke pull from the chamber to the collecting ring where the gas leaves. The adopted solution was a new adjustment of each channel, to decrease the gas velocity down to an appropriate values, avoiding the coke pull, decreasing the cargo loss and avoiding production reduction, or even the unit breakdown.

6.3- Waste Heat Boiler Pipings Holes :

During the beginning of quenching chambers operation, holes occurred in the waste heat boiler's piping, mainly because of the following reasons :

- Failures in the weldings performed during the erection ' stage wich were solved by changing the pipings by corrective repairs.
- Abrasion due to fine dust of the circulating gas, which was solved with the installation of deflectors at the waste heat boiler's top, to protect pipings which were the most affected.

6.4- Dust Circuit Holes :

In some dust circuit parts, basalt coating has been already foreseen, holes in other various parts have occurred, wasn't any previous basalt coating, and this coating was necessary. Is important to mention that the dust transporting system must work correctly in order to avoid the plant breakdown ' due to obstructions.

6.5- The Chambers Refractories Drying and Heating Method:

The recommended method by the project, happened to be improper, because its difficulty to reach the heating previous temperature level and also its difficulty to keep the heating curve. In order to overcome these difficulties, the heating curve has been modified , and a diffuser was adapted to homogenizate the temperature in various chamber's levels , to allow a temperature rise following the new adopted curve.

6.6- Excessive Heating in The Travelling Cranes Painels' Room:

The excessive heating in the painels' room has been decreased by changing the room lay-out and leaving the electric-electronic painels inside air condicionated cubicles. This excessive heating induced innumerous breakdowns, and the unit performance has been affected.

6.7- High Travelling Cranes Motor Vibration :

The high motor vibration was decreased by the introduction' of mechanical changes in the travelling cranes reducers.

6.8- Electrical, Electronic and Mechanical Components :

During the operation, premature wears occurred in some imported electrical, electronic and mechanical components that were not available in the Brazilian market, so they have some temporary changes and after they were nationalized. Up to now there are more than 300 nationalized items.

6.9- CDQ Operational Model :

The CDQ foreseen operational model, considered regular incandescent coke feeding, but this model turned to be impracticable, due to the necessity of a block coke oven batterv operation, in order to allow intervals for preventive maintenance of one of the two available machines groups to

operate the coke oven battery.
As in the blocks operation model there are moments with excess and shortage of coke, we started to operate with the five CDQ's units, not leaving one in stand-by that was previously prejected and was developed one CDQ's operational model with the prechamber levels completely variable in order to absorb the coke oven battery production operating' in block.

7 - OPERATIONAL RESULTS ACHIEVED BY CST :

7.1- Dry Quenching Index :

In CST the dry quenched coke production is about 96 % of the total coke produced by the coke oven battery. The main reason that does not allow the quenching of all the produced coke is the necessity to stop the units each year in order to have the waste heat boilers their inpection required by the legislation. This annual shutdown is also used for preventive maintenance.
In figure 02 the evolution of the production since the start-up is shown.

7.2- Energy Recovery :

The CST plant, was projected for a steam specific generation of 565 kg/t of dry quenched coke, but the practical values are slightly higher - 586 kg/t of dry quenched coke, as it can be observed in figure 03.
Comparisons and equivalent for steam recovery by the CDQ are show in Table V, considering the utilization of all the produced steam.
The distribution of the CST's CDQ produced steam utilization is 89 %, as shown in figure 04.

7.3- Coke Humidity :

The CDQ's coke, is free from humidity when is discharged from the quenching chambers (temperature about 180 ºC), but it absorbs the environmental humidity during its way to the Blast Furnace (sometimes it reaches values between 0,2 % and 0,3 %). The CWQ coke has higher humidity content, and also

presents a high variation according to the median.
Figure 05, shows a comparison between the median and dispersion of the units between DQ and WQ coke produced by CST.

7.4- Coke Strength :

The observed coke strength increase is shown in figure 06 and it is remarkable that besides this increase the main point is its homogeneity of values. These factors contribute highly for the stable operation of the Blast Furnace and also allow the utilization of increasing quantities of soft or even non coking coals in the coal blending, reducing their costs, keeping the coke quality levels under the specification.

7.5- Size Distribution :

The size of DQ coke taken immediately after discharge is smaller than that WQ coke, due to the stabilization that occurs inside the quenching chambers. It can be noticed, by the size distribution curves (fig. 07), the great difference between them in the > 75 mm size quantity. As the > 75 mm size quantity in DQ coke is less than the WQ coke, it is possible to work without coke crushers what it has alreadv been done since 1986 and it has not affected the Blast Furnace coke size distribution and besides that it improved the yield up to 1,3 % between the Blast Furnace coke and the coke taken immediatily after discharge.

7.6- Coke Reactivity :

Reactivity testings, were made in 1985 (not performaded by CST's laboratories), these results did not show important variations between DQ and WQ cokes using tradicionaly used coal blendings. In figure 08 the results of DQ and WQ coke reactivity testing are shown.

7.7- Blast Furnace Operation : (3)

It was possible to compare the influence of WQ and DQ coke in the Blast Furnace operation on march 1986, when, due to the quenching chambers stoppages it was necessary to use a large quantity of WQ coke.

From the data in figure 09, the changes can be observed.

. The top temperature decrease (TGT), and the thermal level (σ Si) variation, had to be compensated with a blast temperature increase.

. Related to the permeability loss (Δ P/V), due to the fine particles retreat decrease, due to the top tempera ture decrease, there were not problems owing to the fact that the blast pressure was in low levels.

The day-by-day operational practice has shown that increasing participation of DQ coke allows stability to Blast Furnace thermal level and operation.
In figure 10, the recent monthly main data achieved by the Blast Furnace 1 are presented, showing its stability mostly ensured by the applied coke quality.

7.8- Other Coke Quality Data :

The ash, volatile matter, fixed carbon data are presented in Table VI, and do not show significant variations.
It also has to be mentioned that DQ coke, on the contrary to the WQ coke, has not adherent fine particles, what is a factor that contributes for the Blast Furnace coke rate decrease.
These data were not presented because the equipment for these testing are not yet available.

8 - CONCLUSION :

. The Coke Dry Quenching Process is nowadays a well-knon and reliable technology.

. Using a Coke Dry Quenching plant it is possible to have an efficient control over pollutive emissions, since the plant has efficient equipment for this purpose .

. High gains due to energy recovery, contributing for smaller dependence on external sources and costs reduction.

. Improvement on coke quality allowing use of increasing quantities of less noble coals, so decreasing the coal blending costs.

. Better homogeneization on coke quality, giving a better Blast Furnace stability, so contributing to reduce the coke rate.

. The process is an alternative to be considered on new steelworks projects, and its implementation on already-existing' steelworks, mainly the ones wich are under revamping stage.

. The process allows high level of automation and certanly it can be performed by our national industries.

. CST is already suficiently skilled on CDQ process in order to ensure a secure and stable operation, and it can take part on assistance for erection/implementation of new CDQ units on steelworks; it can also take part on necessary training since operation start-up up to stable operation stage.

- R E F E R E N C E -

1 - PIVOT, S. et alli - Lo Spegnimento a secco del coke - Boletino Técnico Finsider - May/83.

2 - VILELA BERNARDES, Moisés - Extinção a seco do coque - Technical Contribution presented at "1ª reunião de especialistas" (1st specialists meeting), Ouro Branco - MG, Sept./79.

3 - KAORU, Fujihara - Influência do coque CWQ no Alto Forno - Internal Report OSR/ORF - Companhia Siderúrgica de Tubarão - March/86.

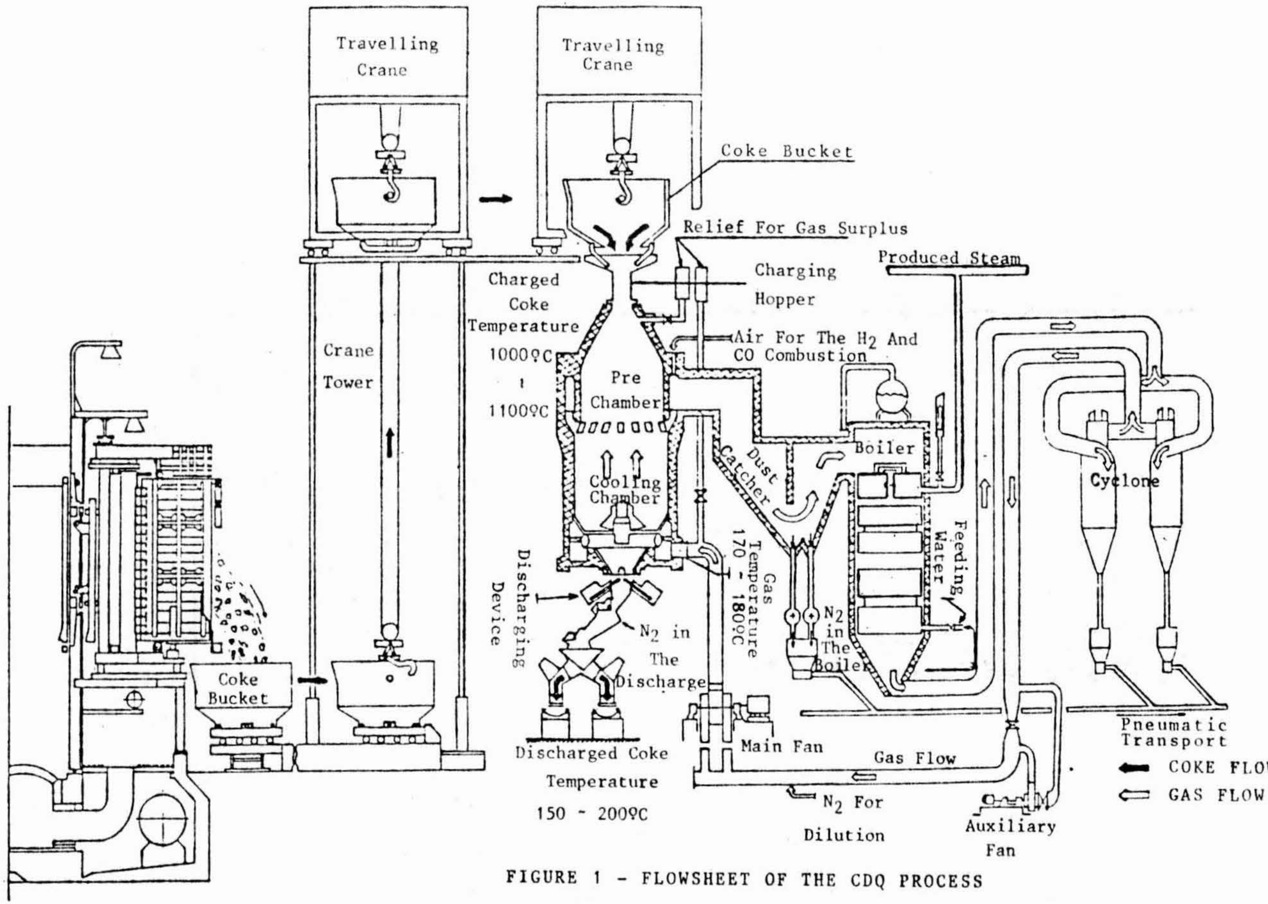


FIGURE 1 - FLOWSHEET OF THE CDQ PROCESS

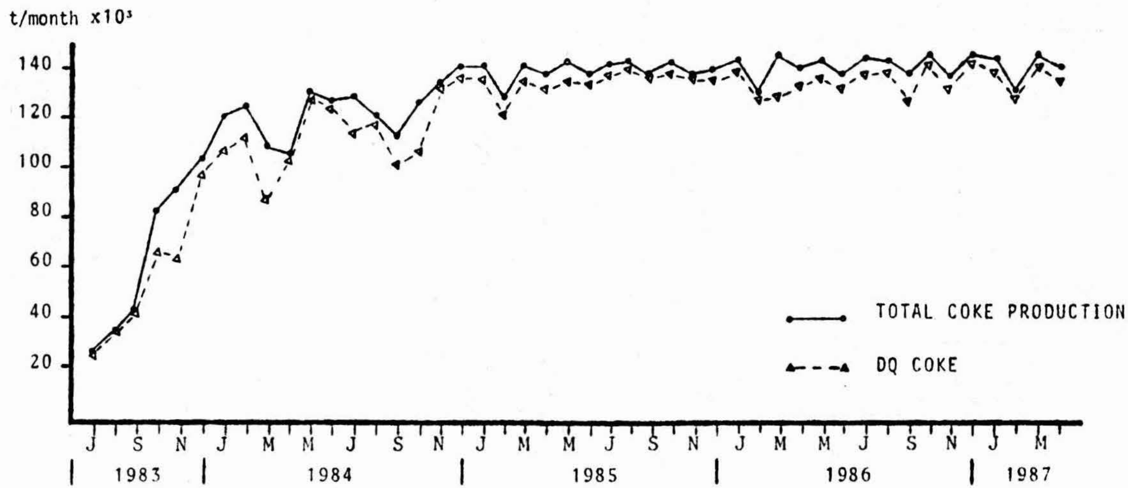


FIGURE 02 - COKE PRODUCTION

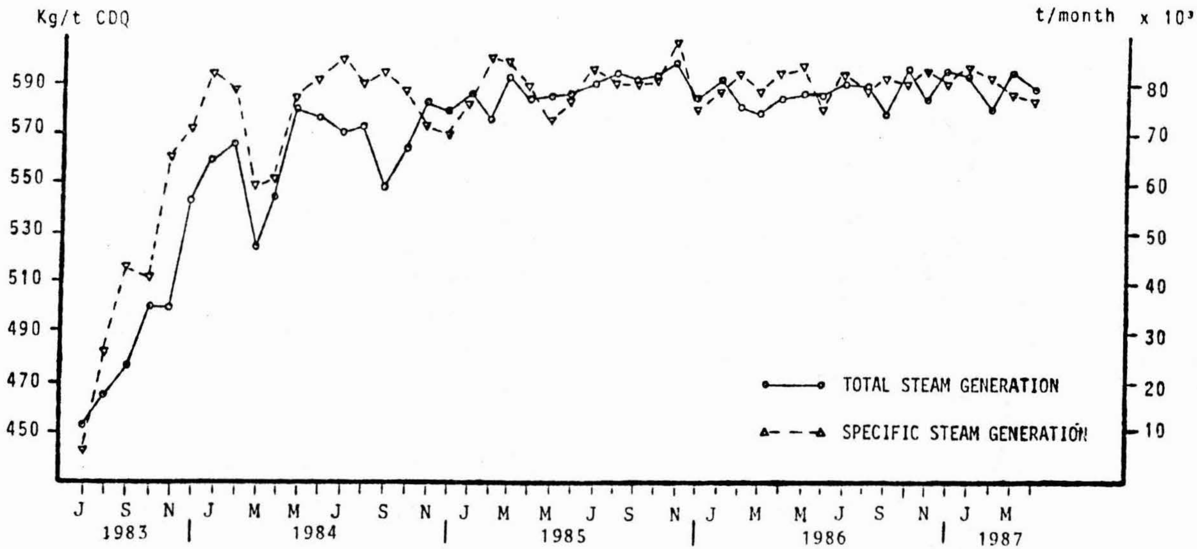


FIGURE 03 - STEAM GENERATION

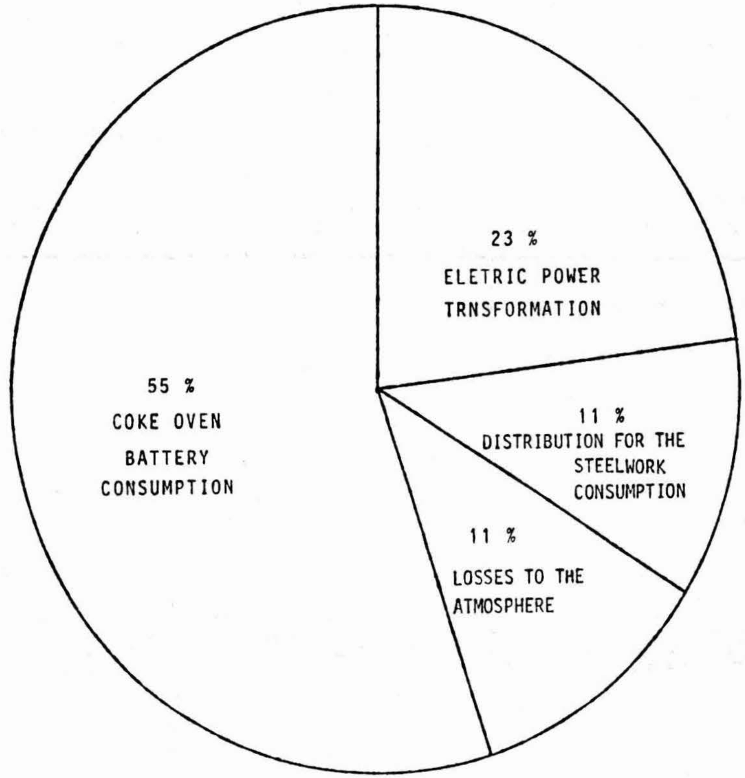
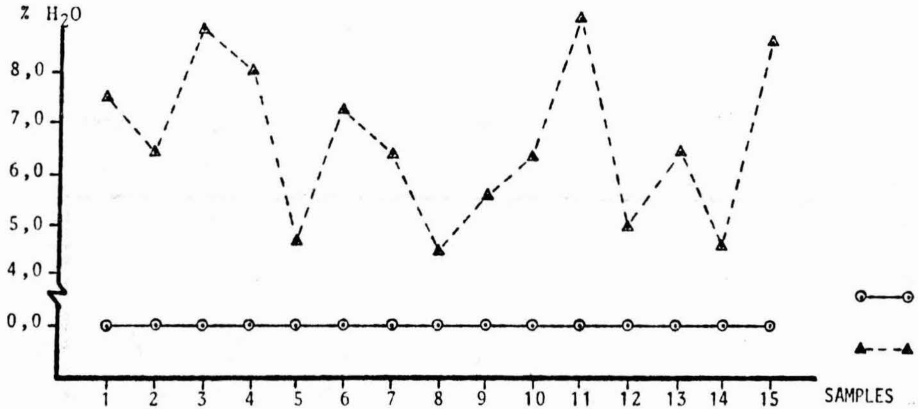
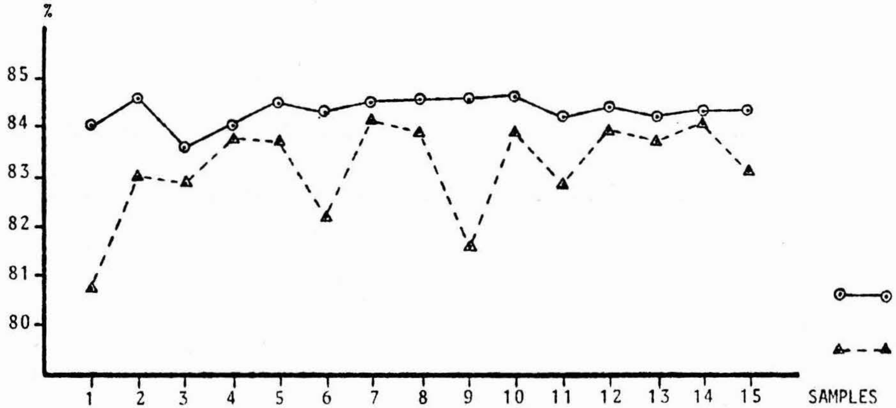


FIGURE 04 - DISTRIBUTION OF THE CST's CDQ PRODUCED STEAM UTILIZATION



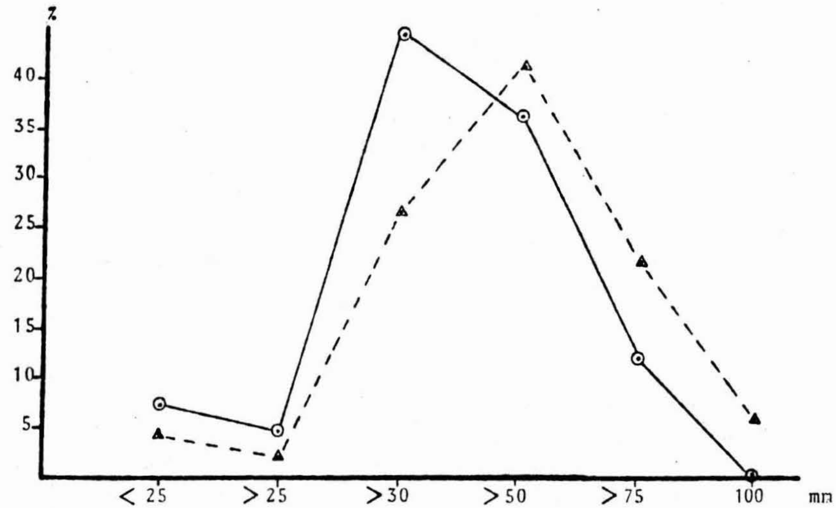
	X	σ	R
CDQ	6,68	1,52	4,7
CWQ	0,0	0,0	0,0

FIGURE 05 - COMPARASION BETWEEN THE MEDIAN AND DISPERSION INDEXES OF C.D.Q. AND C.W.Q. HUMIDITY



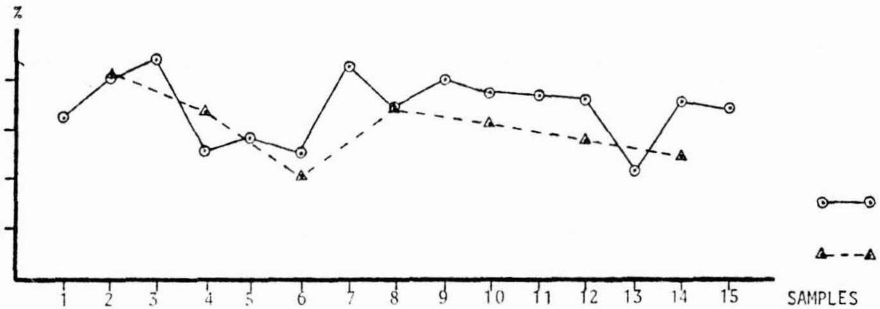
	X	σ	R
CDQ	84,1	0,29	0,90
CWQ	83,0	0,95	3,3

FIGURE 06 - DQ AND WQ COKE STRENGTH



	MS	σ	R
CDQ	51,2	2,43	8,2
CWQ	61,5	4,18	14,3

FIGURE 07 - SIZE DISTRIBUTION CURVE OF DQ AND WQ COKE



	X	σ	R
CDQ	30,8	1,30	4,5
CWQ	30,3	1,27	4,2

FIGURE 08 - DQ AND WQ COKE REACTIVITY

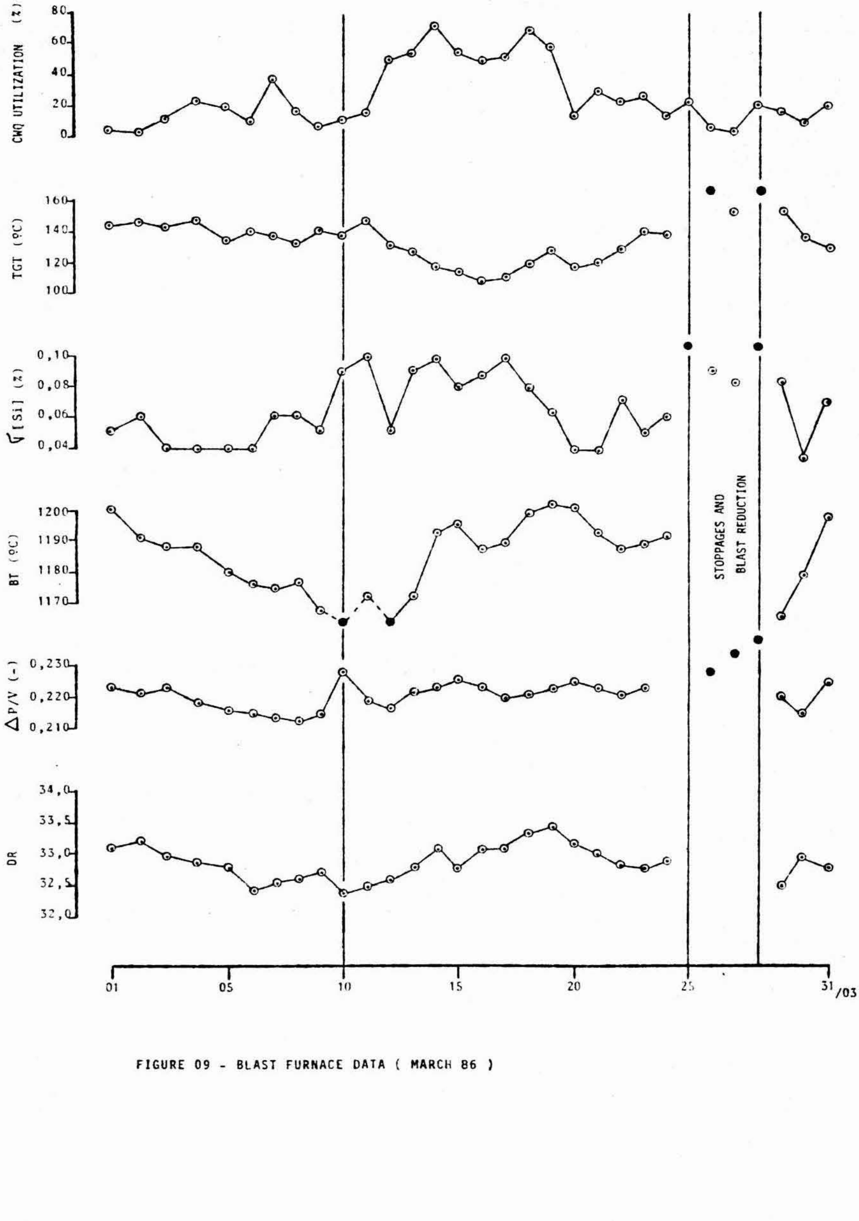


FIGURE 09 - BLAST FURNACE DATA (MARCH 86)

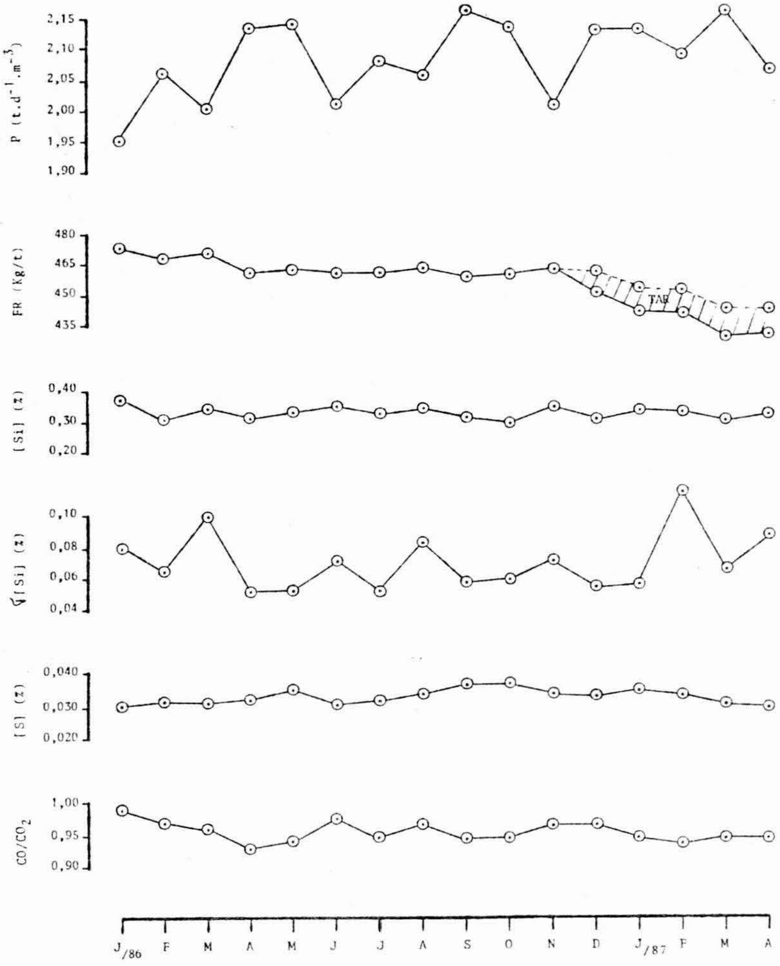


FIGURE 10 - MONTHLY MAIN DATA ACHIEVED BY CST's BLAST FURNACE

TABLE I - DISTRIBUTION OF THE COKE DRY QUENCHING PLANTS NOWADAYS IN OPERATION

PLANTS	PLANT CAPACITY t/h	NUMBER OF UNITS	TOTAL PRODUCTION 1000 x t/YEAR	STEAM PROD, TEMP., PRESSURE t/h, ºC, bar	START-UP YEAR
- USSR :					
Cherepovets	56	5	1460	25/440/40	1970
Cherepovets	56	6	1460	25/440/40	1978
Avdevka	56	8	2760	25/440/40	1965-74
Westsiberian	56	9	2910	25/440/40	1969-71
Karaganda	56	4	1380	25/440/40	1970
Krivoyrog	56	10	3380	25/440/40	1970
Orsk	56	4	1400	25/440/40	1969
Novolipetsk	56	5	1620	25/440/40	1969
Novolipetsk	56	6	1620	25/440/40	1978
- JAPAN					
Tobata	6	1	----	27/440/40	1976
Muroran	85	1	----	39/490/68	1980
Ogishima 1	70	5	----	38,5/270/13	1977
Ogishima 2	70	3	----	38,5/270/13	1979
Chiba	56	3	----	30/220/21	1977
Chiba	100	3	----	74/430/40	1981
Kashima	120	3	----	50/540/103	1982
- BRAZIL					
Tubarão	56	5	1670	26,5/350/23	1983

TABLE II - HEAT BALANCE

HEAT INPUT		
ITEM	QUANT. 10^3 Kcal/t Coke	%
A_1 COKE AT 1050 ºC	360,0	90,52
A_2 FAN ENERGY	8,5	2,15
A_3 COKE+V. MATTER COMBUSTION	20,0	5,03
A_4 BOILER WATER	9,2	2,30
TOTAL	397,7	100,00

HEAT OUTPUT		
ITEM	QUANT. 10^3 Kcal/t Coke	%
B_1 COKE AT 200ºC	45,0	11,20
B_2 SUPERFICIAL LOSSES	15,9	4,00
B_3 DISCHARGE GAS	3,2	0,80
B_4 PRODUCED STEAM	336,6	84,00
TOTAL	397,7	100,00

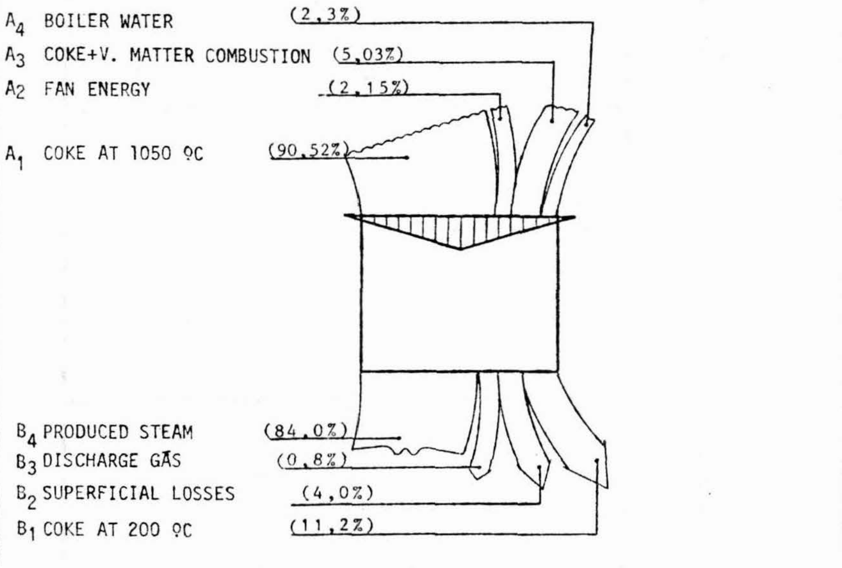


TABLE III - CHARACTERISTICS OF THE CST's CDQ SYSTEM

* PLANT TECHNICAL CHARACTERISTICS:	
- Rated Capacity	52 t/h
- Operation Capacity	48 t/h
- Incandescent Coke Temperature	950 a 1050 ºC
- Quenched Coke Temperature	around 250 ºC
- Chamber Inlet Gas Temperature	around 180 ºC
- Chamber Outlet Gas Temperature	around 800 ºC
- Gas Specific Capacity	around 1500 Nm^3/t Coke
- Steam Hourly Production	27 t/h
- Steam Characteristics - Pressure	23 t/h
- Temperature	350 ºC
- Specific Generation	565 Kg/t CDQ
* QUENCHING CHAMBER:	
- Pre-Chamber - Inner Diameter	5780 mm
- Volume	± 143 m^3
- Holding Time	40 a 50 min
- Cooling Chamber - Inner Diameter	6500 mm
- Volume	± 250 m^3
- Holding Time	2,5 a 3,0 h
- Total Height	± 15 m
- Total Quantity Per Discharge	1.8 a 2.0 t/Coke
* GAS CIRCUIT:	
- Gas Average Analysis:	
- CO_2	$\leqslant$ 14 %
- CO	$\leqslant$ 12 %
- O_2	$\leqslant$ 1 %
- H_2	$\leqslant$ 4 %
- N	$\geqslant$ 70 %
- Dust.............	5 g/Nm^3 (max. 10 g/Nm^3)
- Maximum Circulating Gas Capacity Using Main Fan	160.000 m^3/h
- Maximum Circulating Gas Capacity Using Auxiliary Fan	52.000 m^3/h

TABLE IV - UNITS DATA

CHAMBERS	YEAR	1983	1984	1985	1986	1987
	MONTH	J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M
QC-101	. START UP	21/9 ☆				
	. STOPPAGE FOR INSPECTION/REPAIR		08/5 ▽	15/7 ▽	02/6 ▽	
	. GUNNING DATE		08/6 ◇	22-24/7 ◇	10-12/6 ◇	
	. OPERATION RETURN		10/8 △	22/8 △	03/7 △	
	. QUENCHING QUANT. (t)	80.476	266.663	312.914	337.816	138.032
	. ACCUMULATED QUANT. (t)		347.139	660.053	997.869	1.135.901
QC-201	. START UP	27/10 ☆				
	. STOPPAGE FOR INSPECTION/REPAIR			03/2 ▽	06/7 ▽	
	. GUNNING DATE			14-15/2 ◇	14-15/7 ◇	
	. OPERATION RETURN			04/4 △	20/9 △	
	. QUENCHING QUANT. (t)	24.112	317.320	279.253	285.115	133.098
	. ACCUMULATED QUANT. (t)		341.432	620.685	905.800	1.038.898
QC-301	. START UP		20/1 ☆			
	. STOPPAGE FOR INSPECTION/REPAIR			15/6 ▽	26/4 ▽	
	. GUNNING DATE			24-25/6 ◇	12-13/5 ◇	
	. OPERATION RETURN			13/7 △	29/5 △	
	. QUENCHING QUANT. (t)		286.735	341.598	323.175	129.880
	. ACCUMULATED QUANT. (t)			628.333	951.508	1.081.388
QC-401	. START UP	04/7 ☆				
	. STOPPAGE FOR INSPECTION/REPAIR		01/3 ▽	16/4 ▽	28/3 ▽	
	. GUNNING DATE		09/3 ◇	29/4 ◇	4-5/4 ◇	
	. OPERATION RETURN		24/4 △	24/5 △	25/4 △	
	. QUENCHING QUANT. (t)	123.640	267.745	317.608	319.975	137.270
	. ACCUMULATED QUANT. (t)		391.385	708.993	1.028.968	1.166.238
QC-501	. START UP	04/7 ☆				
	. STOPPAGE FOR INSPECTION/REPAIR		05/9 ▽		02/3 ▽	13/5 ▽
	. GUNNING DATE		21/9 ◇		11-15/3 ◇	25 26/5 ◇
	. OPERATION RETURN		18/12 △		26/3 △	
	. QUENCHING QUANT. (t	100.122	222.618	371.987	331.406	120.182
	. ACCUMULATED QUANT. (t)		322.740	694.727	1.026.133	1.146.315

☆ START UP
▽ STOPPAGE FOR INSPECTION/REPAIR
◇ GUNNING DATE
△ OPERATION RETURN

TABLE V - ENERGY RECOVERY ;

PERIOD	COKE PRODUCTION	STEAM PRODUCTION	Kcal EQUIVALENT SUBSTITUTION		EQUIVALENT COST (CZ$)		EQUIVALENT COST (Cz$)	
	C.D.Q (t)	(t)	OIL (t)	ENERGY (MW)	OIL	ENERGY	OIL	ENERGY
1983	328.350	180.330	13.358	45.082	42.879.180,00	31.467.230,00	1.351.802,60	992.031,21
1984	1.361.081	803.793	59.540	200.948	191.123.400,00	140.261.700,00	6.025.327,90	4.421.869,50
1985	1.623.360	951.780	70.502	237.945	226.311.420,00	166.085.610,00	7.134.660,20	5.235.990,20
1986	1.597.487	941.358	69.730	235.339	223.833.300,00	164.266.620,00	7.056.535,30	5.178.631,80
1987	658.462	391.545	29.003	97.886	93.099.630,00	68.324.420,00	2.935.045,10	2.153.985,50
TOTAL	5.568.740	3.268.806	242.133	817.200	777.246.930,00	570.405.580,00	24.503.371,00	17.982.521,00

EQUIVALENTS:

04 t of steam .... 01 MW

13,5t of steam.......... 01 t of oil

CONSIDERED DATA: (Actual data: april/87)

Oil BFG CZ$ 3.210,00

Eletric Power CZ$ 698,00

TABLE VI - TYPICAL CHEMICAL ANALYSES OF THE DQ AND WQ COKE

CHEMICAL ANALYSIS	C.D.Q.	C.W.Q.
A S H	9,60	9,60
VOLATILE MATTER	0,52	0,56
S U L P H U R	0,61	0,61
FIXED CARBON	89,87	89,83