SESA COKE MAKING TECHNOLOGY

UPDATED AND UPGRADED

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We have presented the Sesa Cokemaking Technology at several conferences including the Intertech Coke at the Crossroads in St. Louis in 2002. The technology has made many significant strides in its progress and development and I am now presenting these to you updated.

1. DEVELOPMENT OF SEQUENCE CHARGING IN THE TOP CHARGED VERSION OF THE TECHNOLOGY

In the top charged version of Sesa Coke Technology that has been operational at Goa for the last 10 years and in a restructured form for the last 7 years, the significant areas of improvement have been the incorporation of the conventional sequence charging mode. The redesigned charge car has flexible telescopic chutes that fit into the charge ports of the various ovens. These are shrouded with a cover shroud that ensures against polluting emissions. The sequence charging (two canisters at a time) ensures a gradual feed of coal and the gradual displacement of air in the oven so that the negative pressure in the oven, which is inherent due to the effect of the hot stack and optimized by the application of suction from the ID fan of the bag filter mounted on top of the Ram car, adequately copes with the displacement of the air.

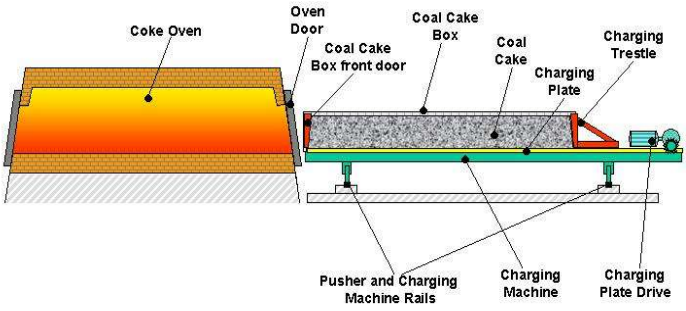
2. DEVELOPMENT OF COMPACTED CHARGING

The most significant development during the last two years has been the development of a system of compacted charging by a German firm. VeCon GmbH have a lifetime of experience in the development of stamp charging and other compacted charging machines.

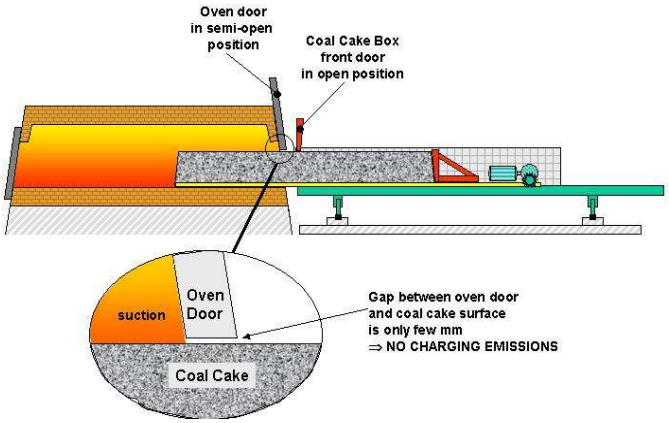
The development of compacted charging for the squat cake shape used in our ovens as against the stamp charging by hammers used for slot ovens took some effort and after the failure of stamp charging which only displaced the coal particles, instead of compacting them they tried improving compaction first by a scheme of vibration from the top and later by vibration of the coal from the bottom. It was proved that the latter produced a superior density of the cake and this has now been standardized upon. The density achieved is of the order of 1.14 tons/cub. metre.

The compacted charging is done in a stationary compacting station and the compacted cake is then transferred to a charge car on a steel plate. The charging car transfers the coal cake into the oven with the help of a winch.

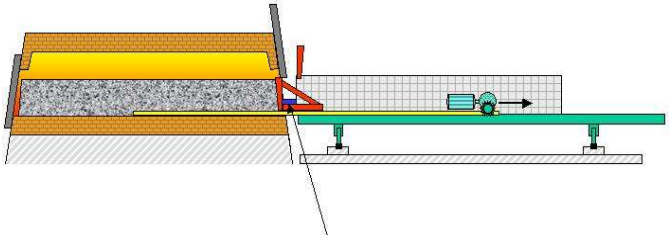
THE ESSENTIAL PARTS OF A COMPACTED CHARGING MACHINE



SITUATION DURING CHARGING OF THE COAL CAKE



SITUATION DURING REMOVAL OF THE CHARGING PLATE



Charging Trestle holds back the Coal Cake
Charging Trestle is locked to the Charging Machine by a stopper
before pulling back the Charging Plate

A VIEW OF COMPACTING MACHINE ASSEMBLY IN PROGRESS

A VIEW OF ERECTION OF COMPACTING STATION IN PROGRESS AT ECEPL

3. DEVELOPMENT OF AUTOMATION AND INSTRUMENTATION CONSEQUENT TO COMPACTED CHARGING

The introduction of the new design of charge cars for the compacted cake, standardized drives for all three cars, proximity sensors for the positioning of cars, door lifting mechanisms mounted on cars, with regulated oven door openings to minimize charging and pushing emissions are all areas of automation than can dispense with operators for the cars and have them operated precisely from a single

point in the control room of the compacting station. Full operational control including a record of wt. of coal and coke and record of all operation can be maintained with PLCs from the control room of the compacting station.

Instrumentation can also be used by way of thermocouples in the oven crown connected up to the PLC in the control room that records temperature movement and can activate air openings automatically (not yet tried out in regular operation)

The Sesa Ovens at Goa are being retrofitted with compacted charging. The ovens at ECEPL have been fitted with compacted charging facilities and are currently under commissioning.

4. OPTIMISATION OF CAPITAL COSTS

Capital costs of the SESA technology are minimized by:

- Use of alumina bricks and special shapes.
- Lower no. of ovens due to higher bulk density of coal charge per oven.
- Manufacture of cars and compacting station components in India although basic design is done in Germany by VeCon GmbH, detailed engineering and manufacture is done in India by FFE Minerals (India) Ltd.
- Possible rebate due to carbon credits for the power plant (where applicable)

A VIEW OF THE FIRST BATTERY OF 150,000 T/A FROM PROPOSED INSTALLATION OF 1.2 MILLION TONNES

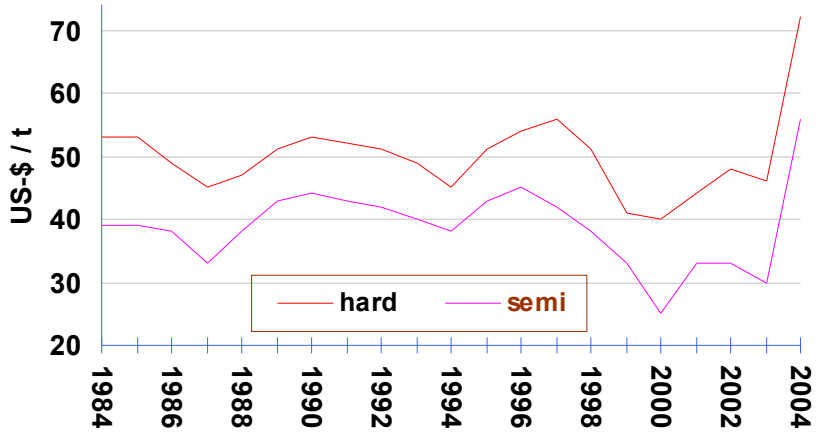
OVENS UNDER INITIAL HEATING

5. LOWER OPERATIONAL COSTS

The operational (including maintenance, water and electricity) costs in India are low at below US $ 4 per tonne coke for the following reasons:

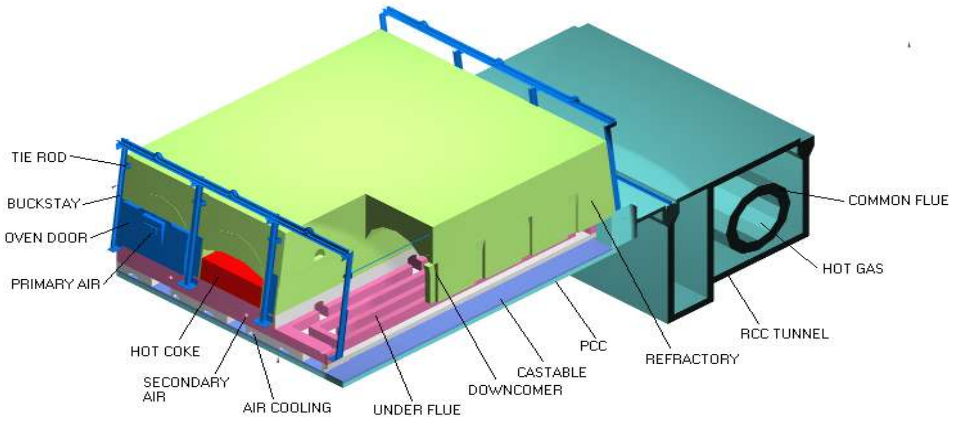
- Good design of alumina refractories involves minimal maintenance.
- Low electrical consumption due to minimum drives. (7 Kwhr /T Coke)
- Low cost of manning due to cost effective mechanization / automation.
- Good process control.

Input costs of coal are low due to a significant saving in coal input costs due to use of 60% semi soft coals in the coal charge



GRAPH OF PRICE OF HARD AND SEMISOFT COKING COAL

There is also an optimisation of coal / coke yield – Lower burning loss. (approx. 1%) consequent to coating of the coal cake with a proprietary coating.



FOUNDATION COOLING AIR IS RECIRCULATED INTO OVEN. UNDERFLUES, AND INTO THE COMMON FLUE TO CONSERVE ENERGY AND REDUCE POLLUTION

6. ADDITION OF COKE BREEZE

In the recent past Sesa has introduced the addition of coke breeze into their coal charge to save input costs. This is a common practice in some parts of Europe where up to 16% of breeze is added in the manufacture of foundry coke after being ground it to below 90 microns in a ball mill after drying.

At Sesa 7% of coke breeze is added regularly into the coal feed (that is all they have of fines)

BALL MILL OF THE SESA COKE FINES GRINDING PLANT

7. EMISSION CONTROL

- The 2003 EPA regulations have been specially addressed in the technology.
- There are no hydrocarbons in the exhaust gasses.
- NO_x levels are controlled by control of oven temperature.
- SO_x levels are controlled by in situ desulphurisatiion and this lowers the load on further desulphurisation
- Charging and pushing emission are minimized by coal cake compaction and precision in oven door openings.
- Controlled automated introduction of tertiary air in the common flues ensures conversion of CO to CO_2 and combustion of all combustible SPM in the common flue.

Sesa Kembla is an ISO 14000 Company and subject to surveillance audit every 6 months.

COATED COMPACTED COAL CAKE READY FOR CHARGING INTO THE OVEN

COATED CAKE PUSHED INTO OVEN (NOTE FLAMES AT SIDE ONLY)

COKE READY FOR PUSHING

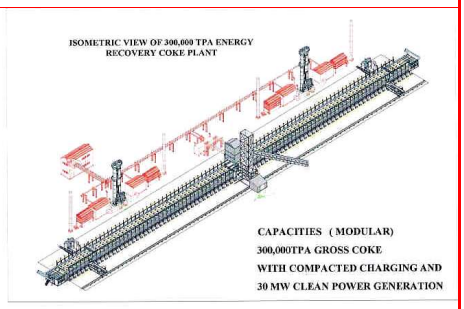
COKE PUSHING WITH MINIMAL EMISSIONS

8. CARBON CREDITS

The power plant is entitled to carbon credits as per the Kyoto Protocal (applicable for signatory countries)

SESA ENERGY RECOVER COKEMAKING

COKE OVENS INSTALLATION AT SESA KEMBLA –GOA INDIA



CAPACITIES (MODULAR)
300,000TPA GROSS COKE
WITH COMPACTED CHARGING AND
30 MW CLEAN POWER GENERATION

EFFLUENTS

- NO SOLID EFFLUENTS
- NO LIQUID EFFLUENTS

COKE OVEN EMISSIONS

EMISSION TYPE	STANDARD NORMS FOR NEW BATTERIES (India)	SKCCL COKE OVENS
SOx (mg/NM³)	800	250*
NOx (mg/NM³)	500	300
SPM (mg/NM³)	50	<50
SPM EMISSIONS DURING CHARGING (STACK EMISSIONS) (mg/NM³)	25	NEGLIGIBLE
SPM EMISSIONS DURING COKE PUSHING (STACK EMISSIONS) gram/tonne coke	5	NA < 5
EMISSIONS FOR QUENCHING OPERATIONS PARTICULATE MATTER gram/MT OF COKE PRODUCED	50	<50

COKE PRODUCT SPECIFICATIONS

PARAMETER	SPECIFICATION WITH TOP CHARGING	SPECIFICATION WITH COMPACTED CHARGING
MOISTURE	5.00% MAX. (4% TYP.)	5% MAX. (3% TYP.)
ASH	12.5% FOUNDRY GR. 10.5% BASIC GR.	12.5% FOUNDRY GR. 10.5% BASIC GR.
VOLATILE MATTER	1.2% MAX (1% TYP.)	1.2% MAX (1% TYP.)
SULPHUR	0.55% MAX (Based on Coal Charge)	0.55% MAX (Based on Coal Charge)
M-10	9 MAX	7 MAX
M-40	80 MIN	80 MIN
CSR	68% TO 74% MAX (DEPENDING ON COALS USED)	65% MIN (DEPENDING ON COALS USED)
CRI	16% TO 20% MAX (DEPENDING ON COALS USED)	18% TO 24% MAX (DEPENDING ON COALS USED)

* SUBJECT TO 0.5% Max. SULPHUR IN COAL CHARGE

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SALIENT FEATURES

- CONFORMS TO LATEST US EPA NORMS.
- TECHNOLOGY PRODUCES SUPERIOR COKE SPECS FOR SAME COAL BLEND.
- LOW CAPITAL COST.
- COMPACTED COAL CHARGE ALLOWS UPTO 70% USE OF SEMISOFT COKING COAL.
- EXCELLENT COKE PRODUCT QUALITY.
- CLEAN ELECTRICAL POWER-MERITS CARBON CREDITS UNDER CDM AS FOLLOWS

CDM POTENTIAL OF SESA KEMBLA COKE OVEN BATTERY		
Capacity, Cogen PP	MW	30
Investment	$ Million	25
Annual Power Generation	mU	243
Energy Merit without CDM	IRR, %	55%
Energy Merit with CDM	IRR, %	60%
NPV Purchase Value of C-Emissions	$ Million	8
As %age of Investment Cost	%	33

•SKCCL IS CERTIFIED FOR ISO 9002 - ISO QUALITY SYSTEM
ISO 14000 - ENVIROMENTAL MANAGEMENT
ISO 18000 - SAFETY MANAGEMENT

A CDM CASE DEMONSTRATED BY THE ENVIRONMENT MINISTRY, GOVT. OF INDIA INDICATING THE COUNTRY'S CONTRIBUTION TO THE KYOTO PROTOCOL

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9. POTENTIAL FOR COKE EXPORTS FROM INDIA

India has no reserves of good quality low ash coking coal but is well located to import coal and export coke. The last two years have seen a very significant increase in coke production in India by merchant coke ovens. The next four years will see an even larger output of coke from the more organized large scale sector with more automated and state of the art technology plants with much lower levels of pollution.

India itself is growing in steel and will hopefully assume the mantle of growth in steel after China (maybe another 15 – 20 years later) but a pick up in growth is definitely noticeable, at present. So growth in coke manufacture is a natural phenomenon.

TABLE OF COKE CAPACITY AND PRODUCTION IN INDIA

'000 TPY

	Capacity 2003	Production 2003	Capacity 2006
Integrated Plants	16810	13690	19510
Merchant Plants	2203	1946	6680