Presenter Name: **INDRANIL ROY**
Paper name: **High performance alternate quality refractory for hearth of reheating furnace.**

PRESENT AFFILIATION	**RDCIS, SAIL**
AREAS OF INTEREST	**Shaped and unshaped refractories.**
Education	**B.Tech in Ceramic Technology**
Experience	• **Design and application of refractories for BOF, Steel ladle.** • **Design and application of refractories for reheating furnaces.** • **Design and application of monolithic refractories.** • **Waste utilization.**
Projects:	• **Improvement in refractory lining life of BOF.** • **Improvement in refractory lining life of Steel ladle.** • **Development of monolithic refractories for application in iron and steel industry.** • **Wealth out of waste.**
Publication/ Patent	**More than 15 international & national publications.** **More than 12 patents filed.**

High performance alternate quality refractory for hearth of reheating furnace

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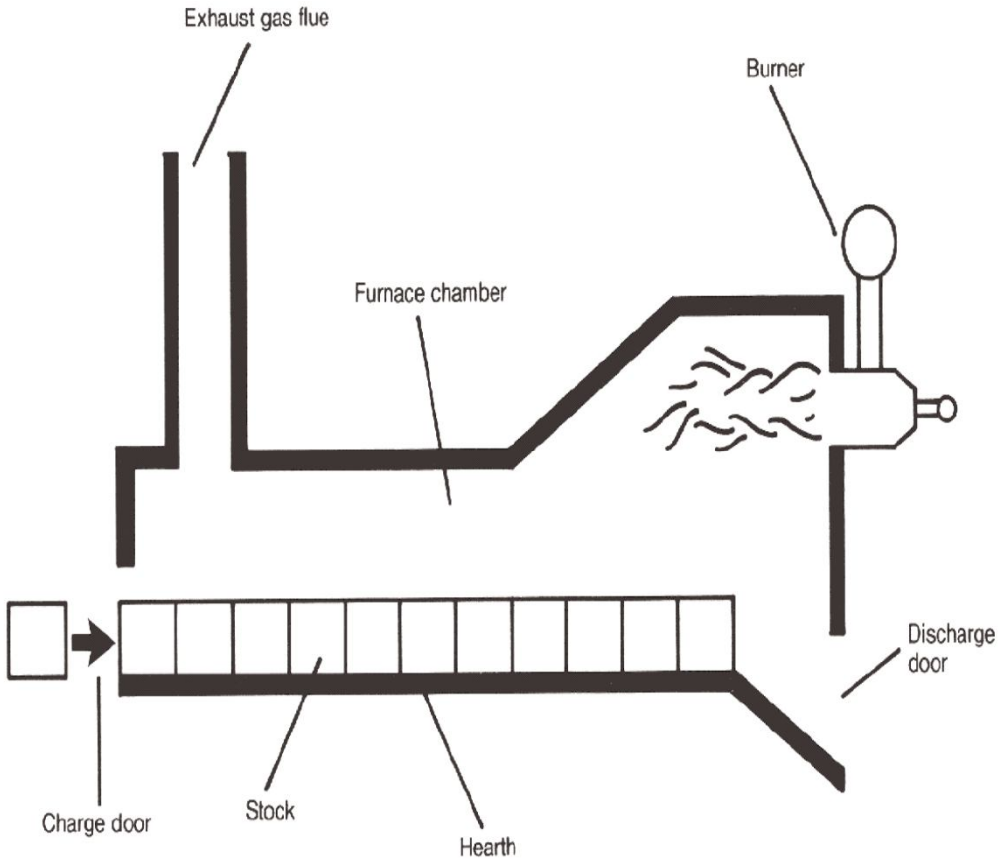
Road Map

- Introduction/ Background
- Experimental details
- Results & Plant trial
- Conclusions

Introduction/ Background

Reheating Furnace of Merchant Mill of DSP



Schematic diagram of Reheating Furnace

- No. of Furnace: 1.
- Type of furnace: Pusher.
- No. of repair/ relining per year: 1.
- Relining schedule: 8 days.
- Fuel used: Coke oven gas.
- Slop of furnace hearth: ~7^0.
- Present refractory in use in pre-heating zone hearth: ZCC block.
- Temperature of different zone:

Pre-heating zone: 900^0C–1000^0C.

Heating zone: ~1150^0C.

Soaking zone: ~1300^0C.

Specification of ZCC blocks

Al_2O_3 (Min.), %	94
A.P. (Max.), %	16
B.D. (Min.), gm/cc	3.15
CCS (Min.), kg/cm^2	1000
RUL (t_a) (Min.), ^0C	1700
PLC (at 1600^0C) (Max.),%	± 0.5
HMOR (at 1400^0C/0.5 Hrs.) (Min.), kg/cm^2	100

The service environment for Pre-heating zone hearth refractory of Merchant mill, DSP

- About 900–1000^{0}C temperature inside the furnace. Refractory need to bear the load of billets at that temperature.

- Mechanical abrasion of Refractory hearth bricks and vibration due to movement of billets during the operation.

- Continuous heating & cooling effect on refractories due to opening of charging door and charging of cold billets.

- Completely solid hearth, so there is no space for volume change for hearth bricks during operation.

Experimental details

Development of High Alumina bricks

- **Selection of Raw Materials**
  - **Andalusite; WFA; Fused Mullite; calcined Alumina; etc.**

  [Keeping in mind about the operating condition (e.g. Continuous heating & cooling; Mechanical abrasion at high temperature; etc.)]
- **Mixing & Pressing**
  - **Molasses was used as green binder.**
  - **Used intensive mixer for mixing.**
  - **Pressed at a specific pressure of 1 ton/cm^2.**
- **Drying @ 110^{0}C for 24 hrs.**
- **Firing @ 1500^{0}C**

Results & Plant trial

A.P., B.D., C.C.S., RUL, & Spalling Resistance

Tests	Comp.–1	Comp.–2	Comp.–3
Avg. Apparent porosity (%)	16.28	14.58	15.88
Avg. Bulk density (gm/cc)	2.75	2.79	2.77
Avg. Cold Crushing Strength. (kg/cm^2)	893	1026	1024
Avg. R.U.L ($t_{a,}$ ^0C)	1600+	1600+	1600+
Avg. Spalling Resistance at 1000^0C, Cycles, Min. (By Water Quenching)	55+	55+	55+

Repeat P.L.C.A.R. & Abradability Index (AI)

Comp.s	Tests			
	PLCAR–1 (%)	PLCAR–2 (%)	PLCAR–3 (%)	A.I. (B.S. 1902: Section 4.6: 1985)
Comp.–1	0.166	0.229	0.073	72.97
Comp.–2	0.027	0.317	0.067	48.12
Comp.–3	0.088	0.133	0.026	43.21

Specification of Developed High Alumina bricks

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Chemical composition	Properties of Developed Bricks
Al_2O_3, %, Min	70.0
Fe_2O_3, %, max.	2.0
Physical properties	
P.C.E., O.C., Min.	36
B.D., g/cc, min. (IS:1528, Part XII)	2.60
A.P., %, max. (IS:1528, Part VIII)	16.0
CCS, kg/cm^2, min. (IS:1528, Part IV)	700
RUL, t_a,^{0}C (IS:1528, Part II)	1600
Repeat P.L.C.A.R., %, max. At 1500^{0}C/ 2hours (PLC will be done as per IS:1528, Part VI)	1st P.L.C.A.R. : ± 0.50 2nd P.L.C.A.R. : ± 0.30 3rd P.L.C.A.R. : ± 0.10
Abradability Index, Max. (B.S.1902:Section 4.6:1985)	45
Thermal Shock Res., Cycles, Min. (1000^{0}C, By Air Quenching)	50

Plant Trial

Trial bricks after installation

Preheating zone hearth lined with developed bricks

Conclusions

- **Refractory lining of reheating furnace hearth has to withstand very high abrasion, thermal shock and high vibration at high temperature.**

- **70% Al_2O_3 containing high alumina brick was developed. This brick has high refractoriness, high abrasion resistance, high volume stability and thermal shock resistance.**

- **Trial bricks were installed in preheating zone hearth and performance is satisfactory.**

- **These developed bricks may reduce the cost of hearth refractory and may also use for other areas with similar operating condition.**


" THANK YOU "
There's a little bit of SAIL in everybody's life