DEVELOPMENT OF ONLINE HOT OVEN REPAIR METHODOLOGY IN JSW NON-RECOVERY

Reji Mathai[1], T K Theepan[2], N Sairama Krishna[3], S M Kumar[4]
JSW Steel Ltd, Salem, Tamil Nadu. India

Abstract

JSW Steel Limited (JSWSL), Salem Works, is the largest special alloy Steel plant in India. The only Integrated Steel Plant in Tamil Nadu, and operates two blast furnaces with a combined production capacity of 1.0 million tons per annum of hot metal. To cater the fuel requirement of Blast furnaces, has a captive Coke oven plant of waste heat recovery type batteries comprising of 120 ovens with capacity of 0.5 million tons per annum of metallurgical coke and generates 34 MW power.

The waste recovery Chinese type Coke oven batteries with silica brick refractories commissioned in 2007 and have an operational life of 15-18 years approx. The healthiness of ovens depends on maintaining temperature and refractory.

This case study describes about diagnosis methodology to repair problematic oven with in-house made insulated cage for online repair of damaged Silica brick oven in short span without compromising inside wall temperature and workman's safety.

Keywords: Coke making, Metallurgical coke, Silica Bricks, Insulated Cage.

Case Study

1. Introduction: JSW non recovery coke oven made with silica brick noted for excellent volume stability used for coking where the temperature is high and direct contact with coal. During the carbonization in coke making process, all VM present in the coal is burnt and flue gas passes through down-comers hole and exit through flue duct header pipe.

The down-comers or intake hole of silica brick lined at oven no. 85 has deformed and collapsed due to aging and poor workmanship. This leading to higher risk operation condition.

It was observed that some bricks were dislocated and collapsed (Fig.1). If not repaired immediately it would have resulted in further collapse of refractory bricks which leads to production stoppage.

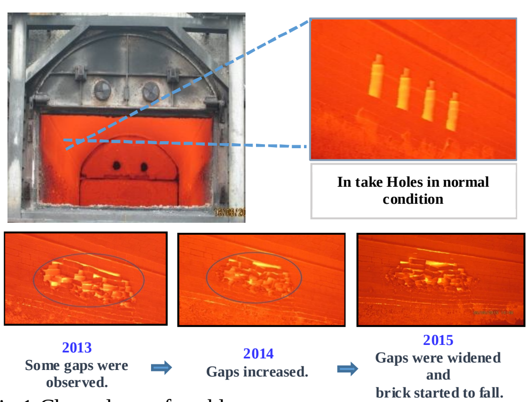

Fig.1 Chronology of problem.

2. Limitations: Silica brick is used to retain heat and hence it should be always maintained above 650°C for longer operational life. Any sudden fall in temperature inside oven below threshold limit of 650°C will result in cracking of bricks which will lead to damaging of oven. Every alternating oven are interlinked and to repair oven no 85, the 12 ovens set (85 to 96) need to be stopped.

3. Conventional method of repair: It involves set of 12 ovens shutdowns for 90 days for new bricks laying, resulting in production loss as well as high repair cost implications.

There was no arrangement or facility readily available to repair of collapsed silica brick in hot condition. The effect was prominently visualized in recent years and condition assessment photos indicated possibility of further deterioration(Fig.1). The challenge was to repair the intake hole brick which is 7 meter inside oven in hot condition and also discussed with other reputed conventional silica welding and oven repair agency but, unable to provide a concrete solution.

4. Unique hot repair: The challenge was to restore the oven condition without losing production. It was overcome by online repair through a specially in-house designed insulated cage. The damaged silica brick of intake hole was replaced with High alumina bricks initially and later by zero expansion bricks. During repair, oven temperature maintained around 800°C and the repair process completed within a short span of 2 Hrs. without affecting other ovens production.

5. Experimental: A mock drill for oven repair was carried out in Oven no.: 115 with fabricated ceramic wool/blanket cage by inserting into the oven directly with help of guide rollers.

Critical Parameter such as Oven inside temperature, Suction, Temperature inside the Ceramic wool cage etc. were noted and it was ensured that work carried out by maintaining minimum 650°C temperature inside the Oven with the stipulated time.

6. Strategies for hot repair methodology:

a) In-house insulated cage 7mtr x 3.4mtr x 1.4mtr was made and covered with 4 layers of ceramic blanket for safe working environment. (fig.2)

Fig 2. Insulated cage

b) Oven top door was modified to accommodate the cage inside the oven (fig.3)

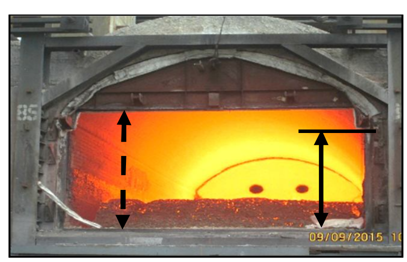

Fig 3. Modified top door

c) Special heat proof safety PPE's were arranged for additional safety of manpower and analyzed the potential hazards through FEMA & JSA. (fig.4)

Fig 4. Online Hot repair

d) CO gas analysis, wall & cage inside temperature was continuously monitored for both oven's as well as manpower's healthiness. (Chart 1)

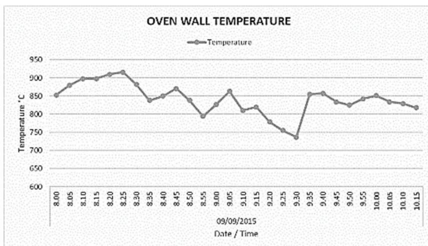

Chart 1. Temperature profile during repair

e) Online & hot repair activity was successfully executed in oven no: 85 within 2 hrs. by replacing with 41 nos. high alumina bricks.

Table 1. Dismantling and erection bricks details.

Oven no 85 Q/S intake hole silica brick dismantling during repair			
Sl. No.	**Brick type**	**Brick Size**	**Qty in Nos**
1	Z 05	347x171x65	8
2	Z 06	347x115x65	7
3	Z 09	290x230x65	6
4	Y 44	460x170x65	4
5	Z 15	230x230x65	6
6	Z 18	230x115x65	4
7	Z 17	230x171x65	6
		Total	41
Oven no 85 Q/S Intake hole high alumina brick erection during repair			
Sl. No.	**Brick type**	**Brick Size**	**Qty in Nos**
1	HA 70%	347x171x65	20
2	HA 70%	347x115x65	4
3	HA 64%	290x230x65	12
5	HA 64%	230x117x65	4
		Total	40
6	90% Alumina Castable		150 Kgs
7	70% Alumina Mortar		500 Kgs
8	90 C Castable		25 Kgs

f) Further planned to replace by imported innovative zero expansion brick for longer stability.

g) These are fused silica bricks having zero thermal expansion (ZE) modules, used for repair coke oven silica bricks. This bricks are designed for self-locking mechanism and once it is fixed in the oven it can be firmly finished with ceramic welding. Each bricks weigh 5.4 kg size (420 x 122 x 70 mm) (fig.5)

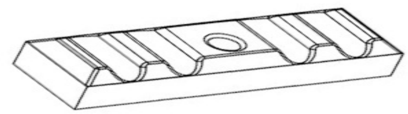

Fig 5. Zero expansion brick with groove

7. Results:

Before **After**

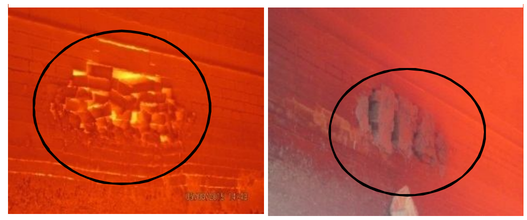

Fig 6. Repaired intake hole

8. Conclusion:

A new window is opened towards in-house restoration of problematic ovens with confidence to meet future requirement. Significant cost saving by eliminating high repair cost and production loss.

9. Acknowledgement:

The authors are thankful to Shri. D. Ravichandar, CEO, M/s. JSW Steel Limited, Salem Works and Senior Managements of JSW for providing facilities for developing unique repair methodology.

10. References:

[1] K.B. Nagashanmugam and Reji Mathai., The Influence of Coal Ash Chemistry on the Quality of Metallurgical Coke., Coromandal Journal of Science., **Vol. 1, No. 1**, December 2012. pp.60-64.