“Methodological Eviction of complications during Coke Dry Quenching Process in the department of Coke Ovens”

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ABSTRACT

Coke Dry Quenching (CDQ) is a system where hot coke removed from coke ovens at a temperature of approximately 1,000°C is cooled and kept dry with inert gas and the resulting steam produced in a waste heat recovery boiler is used to generate electricity. As the sensible heat recovered by heat transfer in the cooling chamber is utilized as a heat source for steam generation, electricity generated by CDQ is clean, environmentally-friendly energy. In addition, compared to the conventional wet quenching type, CDQ brings about advantages such as the reduction of dust emissions and improvement of coke quality. In this project work, various problems which are associated with CDQ process have been evicted by way of considering all the technical aspects to solve the complications in respect of evicting the fallen of bucket liner plates, enabled smooth flowing of coke in a slide gate hopper and setup the CDQ brick furnace wall as per the requirements. The detailed modification of these aspects can be found in results and discussions of this project work.

Keywords: *Coke Dry Quenching (CDQ), MOC, Bucket Liner, Blast Furnace*

1. INTRODUCTION

As long as industry technology develops, the man power factor would be reduced, machine factor would be increased automatically. This situation has been occurred in large scale industries and it is also growing in developing country like India. By 2050 in India there is a tremendous change would be taken place where entire industrial sector would be run without assistance of man power. So being an engineer our objective is to give good product to the customer and we will commit towards their requirements and satisfaction. In this work we try to enhance the productivity of aforementioned system by means adopting different techniques. In this study we reckoned an industry (Jindal Steel Works [JSW]) where we allocate the tribulations which associate with existing one and enhance the productivity of a system and eventually, we obtain the best possible results. So, in this respect the reckoned industry has produced different products like cold rolled products, steel channel products, hot rolled products, Galvanized Products, Pre-painted Galvanized, TMT bars, Wire Rods & Special Steel Bars, Rounds & Blooms. Usually, persons who works in a steel industry could find evils which are commonly associated with furnace, batteries of a machine, quenching machines, power related evils, lift carrying machines, cranes troubles, charge ignition harms etc… these kinds of troubles could be found by a person who are engaged to the respective department. In our day-to-day industrial activity, we can notice the problems which are associated with aforesaid parameters.

2. PROBLEM IDENTIFICATION AND RESOLVING PROCEDURE

With respect to the coke oven systems, we have identified number of problems which are being associated with Accumulation of coke fines in hopper.

2.1.Problem Identifications in respect to Hopper

a. Slide gate getting jam frequently

During stoppage of discharge slide gate cannot be closed for maintenance so CO gas leakage at discharging area.

Fig.1.1: Slide Gate Hopper

In prior approach, there is always some positive pressure in coke discharging zone due to gases coming from slide gate as leakage, which is unavoidable without stopping plant for a long time (Plant shutdown lasted for few hours to days for making coke discharging zone completely free from hazardous gases even sometime more than this depending on type of job need to be carried out in coke discharging zone of plant). According to prior set up, gas flow current for hazardous gases created by suction system goes through working zone and critical machine s which is critical from safety point of view as well as takes more time for engineer s to start maintenance job as temperature of gases remains too high to enter in coke discharging for CDQ plant.

Thus, according to prior approaches, one of the main drawbacks in coke discharging zone was that it was not easily accessible to carry out hot jobs (such as welding and gas cutting which system frequently required in case of any breakdown) due to deficiency of oxygen and High CO gas and there were chances of formation of explosive gases due to confined space zone.

Another main drawback with prior approach is during repair/replacement of machines in coke discharging zone. Sometime due to major problem in coke discharging zone, replacement of rotary seal valve or Vibrofeeder is required. In the existing system, the gas flow being routed through these machines, access to CDQ equipments was very difficult due to hazardous gases as well as due to high temperature of gases which use to come from chamber through slide gate as leakage.

Moreover, existing vacuum/suction line (dedusting system) gas flow current was unable to handle gases effectively as route for gases was through working zone. In order to make access inside coke discharging zone, system required a delay to start job (starting from few hours hrs to more depending on plant condition and type of breakdown), causing loss of steam generation and dry quenched coke which further used to minimize productivity of plant.

Thus, the basic technical problem of existing vacuum/suction line is that it was not possible to extract hot and hazardous gases from discharge zone of CDQ plant where the suction line is connected to Vibrofeeder casing as a cyclone type situation arises near manhole where mixing of hazardous gases happens with atmospheric air due to large volume of leaked gases, secondly tendency of coke discharging tray (Vibrofeeder tray) is to divert gases towards inspection door.

b. Life Enhancement of CDQ Sloping Flue Pillar Bricks

The increasing focus on sustainability of Steel Industries worldwide has brought in new trends viz maximizing utilization of assets, reduction of energy consumption and carbon footprint. Coke Dry Quenching (CDQ) technology for recovery of waste heat from hot coke to generate process steam and power is well established and adopted worldwide that meets these objectives of sustainable operation.

Conceptualizing and executing CDQ technology in CDQ site conditions throws up many challenges requiring innovative approach for technically and financially feasible solutions. The complexity of the situation is compounded with the requirement of proper technology selection based on space availability, synchronization of CDQ operation with oven pushing schedule, integration of the process with existing system, keeping the existing Coke Oven Batteries (COBs) operative as well as adhering to maintainability, process safety protocols and constructability of new facilities within the project execution schedule.

Fig.1.2: View of CDQ Pillar, Flat Arch & Ring Duct

It is well known that Coke Oven Plant is one of the major sources of pollution in an integrated steel plant. Most of the COBs in India installed earlier are with traditional wet quenching process and in many cases without having proper pollution control measures. To keep pace with changing technologies and needs of sustainable development as per Central Pollution Control Board (CPCB) norms, installation of CDQ Plant is deemed essential to reduce carbon footprint for the plant, water and air pollution. Additionally, water conservation and energy saving through waste heat recovery is achieved for any Iron and Steel making facility. Government of India (GOI) has already notified that Environmental Clearances will not be given for new COBs as well as standalone brown field sites and encouraging installation of the same in the existing COBs.

The facilities for the new CDQ plant are to be constructed while the existing operating plant needs to remain in operation for all brown field sites. This imposes various challenges on the proposed layout of the units for the new CDQ plant considering the aspects of construction of foundations and other technological structures in proximity to the existing structures of operating plant, logistics for material movement, construction & erection of equipment and also maintaining complete safety for the new installation and existing operating plant including people.

3. RESULTS AND DISCUSSION

3.1.Modification of CDQ Slide gate Hopper

- Angle of drain line and pipe size has been changed.
- Provision of man hole for periodic cleaning of hopper.

Fig: 1.3: Modified CDQ Slide Gate Hopper

3.2.Solution for Life Enhancement of CDQ Sloping Flue Pillar Bricks.

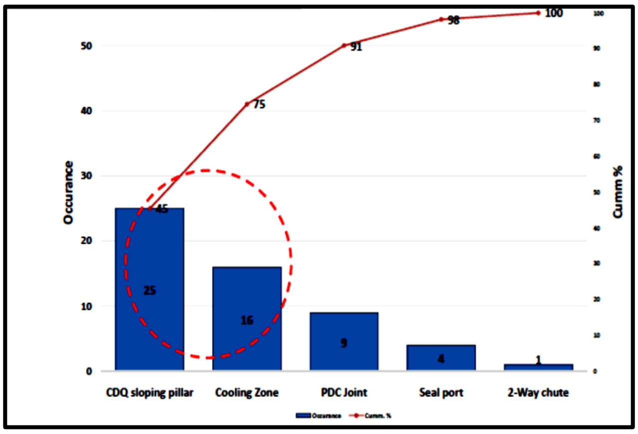

Fig: 1.4: Failure Analysis Chart

Possible ideas Generated from failure analysis chart

i. Repair of Complete pillar during yearly maintenance.

ii. Filling of Cracks by Refractory mortar.

iii. Upgrading the Quality of Refractory bricks.

iv. Reducing CDQ process temperature fluctuation.

v. Strengthening of Pillar lining by repairing the first layer completely.

vi. Strengthening of pillar lining by repairing 2 layers

vii. Coating the erosion area to avoid unwanted gaps.

viii. Increase the width of pillar bricks.

ix. Providing a sliding expansion joint between 9,3 series bricks

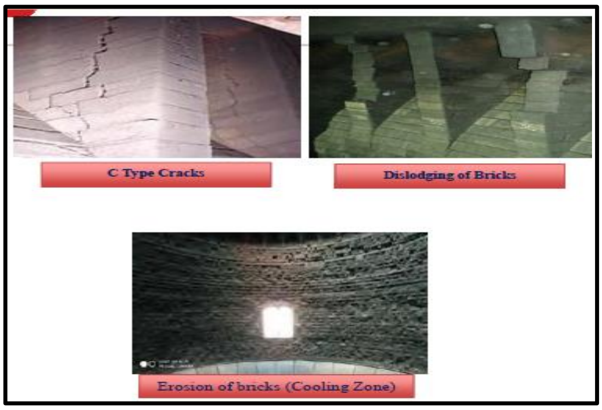

Fig:1.5: CDQ Brick Analysis

3.2.1. Eventual Validation of Ideas by PDCA Cycle

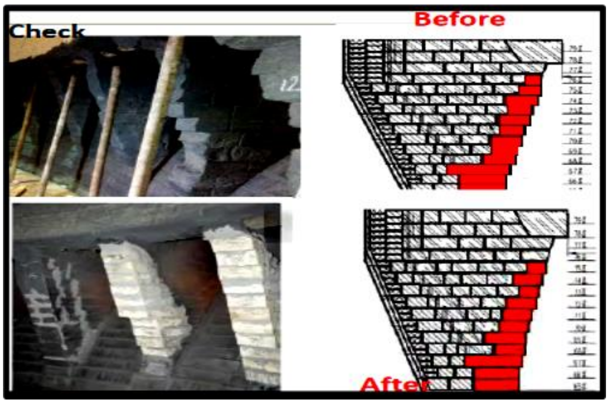

Fig: 1.6: CDQ Brick of PDCA Analysis

PDCA-1

➢ **Plan:**

1. Strengthening of pillar lining for having better Mechanical & thermal stability.
2. Gunning of cooling zone area.

➢ **Do:**

1. Dismantling & relining of Sloping flue pillar refractory to first layer
2. Gunning of cooling zone area with 60 % Castable.

PDCA 1 Conclusion

- C type cracks minimized.
- No improvement in dislodging of Refractory bricks.
- Relined bricks found at the discharge chute within 3-4 months of installation.
- Due to gunning in cooling zone area further brick damage is controlled.

Inference of PDCA-1

Understood that dislodging of bricks is due to 2 factors namely improper locking & inclination of 76 degree provided in the pillar design. so planned for dismantling & relining of sloping flue pillar up to 2^{nd} layer.

PDCA 2

- **Plan**

  Strengthening of pillar lining by repair up to 2 layers namely (9,3 series bricks) with upgradation in quality of bricks.

- **Do: -**

  1. Upgradation in quality of Refractory bricks for better thermal mechanical stability.

  2. Irrespective of damages of sloping flue pillars it is being decided to dismantle & Reline of Pillar Refractory brick up to 2 layers.

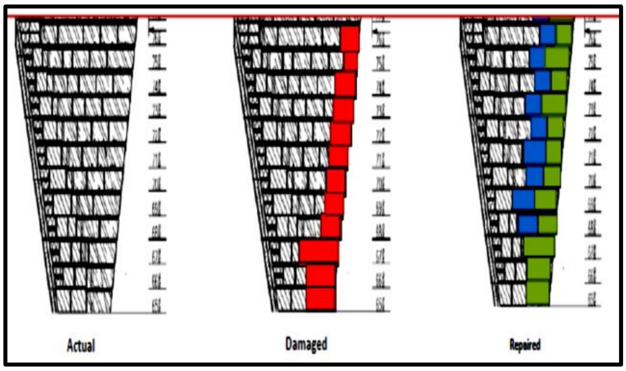

Fig: 1.7: CDQ Brick of PDCA Interference Results

PDCA 2 Eventual results

- Dislodging of Bricks was minimized.
- No cracks develop during the operation.
- Minor erosion in pillar bricks.
- No bricks were found at discharge end.

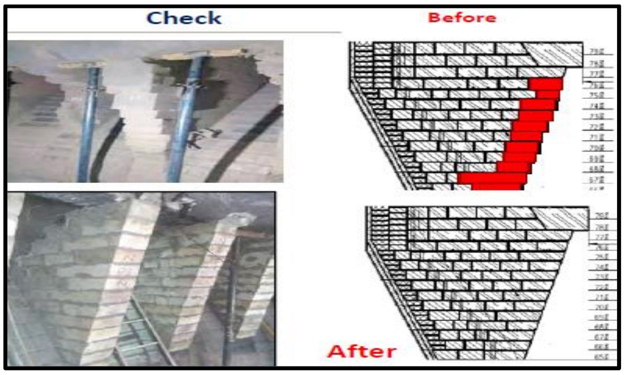

Fig: 1.8: Enhancement of CDQ Brick

Inference

- Pillar lining service life improved to two years.

CONCLUSION

As a matter of fact, keeping in view of bucket liner modification, CDQ sliding hopper gate modification and coke dry quenching brick furnace modification eventually the following conclusions are drawn.

- Reduced the frequency of slide gate malfunctioning (full open/close).
- No CO gas was found at discharge area, hence easy maintenance of discharging equipment's can be done.
- Dislodging of Bricks was fully minimized.
- Pillar lining service life improved to two years.
- To maintain the better efficiency in the coke oven system.
- To maintain the superlative efficiency in the production system.
- To optimize the process parameters to keep the CDQ in better controlling condition.

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