Hot Repair of Coke Oven Batteries

1. About Coke Oven Battery:

Coke is a fuel required as input material in blast furnace for reduction of Iron ore to produce Hot metal and to further process for steel making. The coke is produced from Coal by heating it in absence of air in coke oven batteries called as carbonisation process. Coke oven battery (7mtr tall battery) is cubical structure of dimension of about 100Mx16Mx16M in which 67 Ovens /68 Heating wall are made of refractory bricks (Silica , Fireclay and Insulation bricks) and hold with massive anchorage system consisted of Flash plate ,Buck stays ,springs loaded Cross tie rods CTR and longitudinal Tie rod LTR. RINL has 5 numbers of 7 meter tall top charging Coke oven batteries operating to produce coke round the clock, for use in our blast furnaces, to make iron (Hot Metal). Each of these batteries has 67 ovens for producing coke. Each ovens have dimension of (L x H x W) = 16 M x 7 M x 385 mm P/S & 435 mm C/S (50mm taper).

About 32 ton of the coking coal is charged in the powder form through three charging holes with the help of screw feeder of charging car from Oven top and coal is levelled by leveller bar of pusher car from front side of batteries. The ovens are heated by CO gas and mixed gas in flues of heating wall made of silica bricks (heat conduction properties) between each oven (32 numbers of heating flues per heating wall). After coking period of about 16 -20 hours coal is converted to coke inside ovens with maintaining heating wall temperature of about 1250-1300 deg with coke mass temp of about 1050 Deg C . Hot coke is pushed by pusher car from front side and hot coke is collected in buckets at the coke side / back side of batteries. About 25T of coke is produced (75% yield) in each pushing .

2. Hot Repair of COKEOVEN Battery:

2.1 Introduction

The operating life of a well-designed Coke oven battery should exceed twenty-five years under normal operating conditions and regular battery maintenance. Usually after 10-15 years of service specific repairs of the refractoriness, anchorage and the machinery is required. Repairs are identified during scheduled inspection. Major planed repairs are to be carried in the following areas of Battery.

1. Full hot wall repair (all 32 Flue repair), 2. End verticals Repair (1-6 flue from end side i.e pusher side /coke side of heating wall) 3. Anchorage changing and regulation , 4. On line hot repair of oven.

During hot repair, the oven under repair and side ovens are to be kept empty and heating wall temperature to be maintained up to 900 Deg C. Damaged part of refractory or anchorage are to be changed.

2.2 Hot Repair steps:

The following steps are followed in hot repair of ovens of a coke oven Battery.

- Detachment and Locking of mechanical Anchorages of ovens

- Door removal and temperature to be reduced from 1300 to 900 by disconnection of end flue burner of to be repaired and side ovens,
- When the to be repaired oven slightly cools down to a temperature of 800 to 900 degree centigrade, manual dismasting of heating wall from oven top and covering of wall with ceramic blanket and side wall to be hold with pipe jacking
- The other mechanical anchorage like flash plate buck stay machinery attached to the ovens are to be removed.
- The new refractory lining is to be carried out by maintaining required dimensions as per design.
- The mechanical anchorage is then refitted with proper load as per design.
- The repaired heating wall reheated for 3 to 4 days to get a temperature of 1250 deg C.

3.0 Solution Required:

In the present practice the repair personnel are exposed to high temperature due to this their health gets affected and at times their life is in danger.

The star-up is required to design and develop COBOT (Co-working ROBOT) to assist repair staff to carry out the “Hot Repair” jobs. The Cobot /robot is expected to do the job of repair personnel as far as possible , so that human exposure to hot temperatures avoided and it also shall help in speeding up the process of repair.

Some of the pictures are presented below to give a better understanding of the problem.

Coke oven from view from Pusher side (Fig-1)

Battery from coke end after removing door Temp: 1050 degree centigrade (Fig-2)

Blanketing of ovens for repair ovens using ceramic fibre blanket refractory wool Temp: 1000 degree centigrade (Fig-3)

Heating wall created for work: In side heating wall temperature 800 to 1000 degree centigrade (Fig-4) ambient temperature about 50-60 deg centigrade

Refractory fitting under progress: ambient temp 50 to 60 deg C. (Fig-5)

Work under progress