

Hot Repairs in Coke Batteries under operation



thyssenkrupp has an illustrious history and association with the coking industry spanning over 150 years, having built in excess of 500 coking plants and installed twice the number of coke oven batteries. thyssenkrupp experts are widely considered the go-to persons when it comes to this segment of the steel industry. They are pleased to share with you our expertise and knowledge in the form of articles from past few months.

All our articles are reproduced with the prior permission of thyssenkrupp. It is not permitted to further reproduce this article in part or full. For more information with regard to the content of the article, or assistance on your projects, please email : amit.mainde@thyssenkrupp.com

In our earlier article titled **“Inspection of Coke Oven Batteries”** we had provided you an insight of why inspection of Coke Oven Batteries is important and various methods to do so.

Inspection at regular intervals helps our esteemed clients to identify cracks and other defects in the refractory at an early stage which helps our customers to take corrective action without having a major impact on CAPEX & OPEX. We also touched upon increasing the efficiency, reliability, availability health & safety of working staff as well as optimization of maintenance resources.

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 refractories, steelwork and the machinery are required. Repairs are identified during scheduled inspection. These repairs, if properly performed, will extend the life of the battery for more than ~10 years, however, there is a continued slow and gradual deterioration taking place at all times. Nevertheless they help improve efficiency, reliability, availability health & safety of working staff as well as optimization of maintenance resources.

The refractory brickwork and the mechanical equipment of coke oven batteries are exposed to high thermal and mechanical loads during their operation for many years.

If banked tensions occur, damages can enter.

The most frequent causes for damages at coke oven batteries are

- Emission problems
- Operation problems
- Raised wear
- insufficient anchorage system
- very propelling coal mixtures
- inadequate servicing
- negligent operating method
- unfavorable climatic conditions

as well as normal wear and tear at the end flues of the heating walls due to material behavior at temperature changes like thermal shock.

These damages lead to disruption in operation, losses of production and raised pollutant emissions. If not treated with the means of repair these damages continue and lead to the disabled state of the battery where at least the battery need to be teared down. Often a new battery will be built on the same base plate afterwards.

During new erection of the battery the production drops out completely. The operator not just has to invest in a new

battery, he even can't earn money due to the loss of production.

The refractory block consists of three main types of refractory materials, which differ significantly, in their characteristics. The three types of refractories are as follows:

- Silica Brick, Coke Oven Quality (Per DIN 1089, Part 1)
- Zero Expansion Bricks
- Fireclay Brick, Coke Oven Quality (Per DIN 1089, Part 2)

The difference in expansion behavior poses a very special challenge during the initial battery heat-up and during the operation of the battery in consideration to temperature changes.

A heating wall consists of a number of individual bricks joined together vertically and horizontally with mortar. These joints will crack first when movement at the bricks occurs. The movement can be caused by forces, such as the swelling pressure and/or friction of the coal, introduced during pushing from the pushing ram and the moving coke, particularly during a hard or unequal or nonlinear push as well as forces introduced by thermal shock.

The heating wall bonds and, in particular, the connection between the liner and the binder is of great significance for the stability of the coke ovens. To keep the integrity and the stability of the heating walls and the therefore the whole battery regular inspections as well as the maintenance particularly of the mechanical anchorage system is essential.



Fig.1: lay-out of a heating wall combined of liners and binders

Determination for the scope of work

At reasonable intervals, a refractory and mechanical specialist should make a thorough inspection of each oven. Damages must be recorded on special inspection sheets. The kind and area of damage has to be reported graphically using the given symbols. In addition, the battery can be scanned by means of 3D- Scan to examine the dimensional changes and extensions of the battery. An additional drone flight will also provide information about hot spots, leakages, the mechanical integrity and possible gas

leakages. For the examination of the inner walls images can be taken and analyzed. If operation data like pushing schedules, pushing forces and temperature developments are available a comprehensive analysis of the state of the battery can be conducted and the required rehabilitation measures defined.

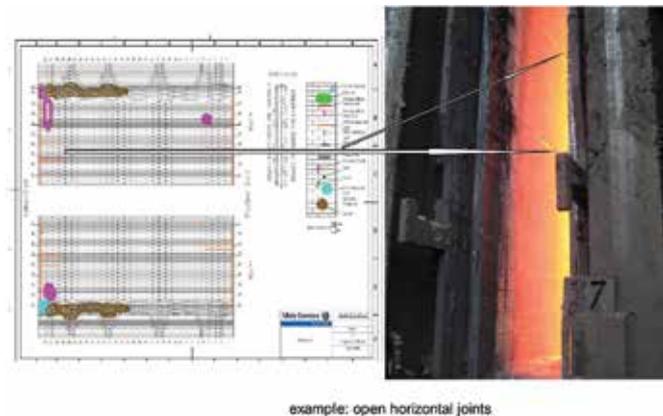


Fig. 2: Inspection sheet shows damages in the heating wall

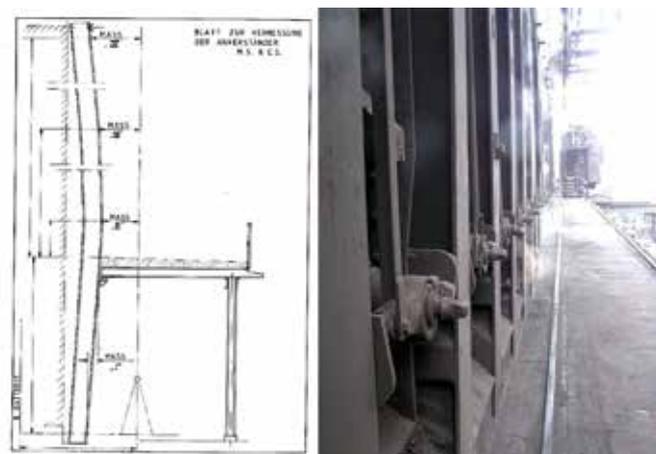


Fig.3: Measurement sheet for the buck stay alignment

Depending on the results of the inspection report, the maintenance measures and repair procedures will be determined.

With regard to the mechanical equipment, damaged doors and doorframes, armour plates, deformed buckstays or cracked springs and tierods, will be renewed often partially.

Referring to the refractory, damages could be expected mainly at the end flues, but also damages in the middle of the heating flue can occur and sometimes complete walls will need to be changed. Areas for repairs are also the roof of the battery often combined with the adjustment of the charging holes or exchange of tie-rods, the oven floors, the regenerator and the corbel area.

To adjust the dimensions of an extended battery a detailed repair engineering is required. The dimensions of the bricks often divert from the original design and the material must be chosen accordingly. To avoid cracks due to thermal shock in the repair zone, material knowledge is essential maybe zero expansion material must be used.

The hot repairs at the heating walls can be executed at single walls, at group of walls and a complete refurbishment of a battery by repairing the walls block wise is also possible. Because the production loss is reduced to a minimum a partial repair of a coke oven battery is very attractive and economically favorable.

Depending on the requirements of the client the repair steps can be executed with minimum 2 heating walls up to 6 heating walls depending on the oven type.

Figure 4 shows the break lines for an endflue repair of 3 heating walls.

As can be seen it is necessary to keep 4 ovens empty and for safety reason and a better heat control, the adjacent oven chambers are also empty.

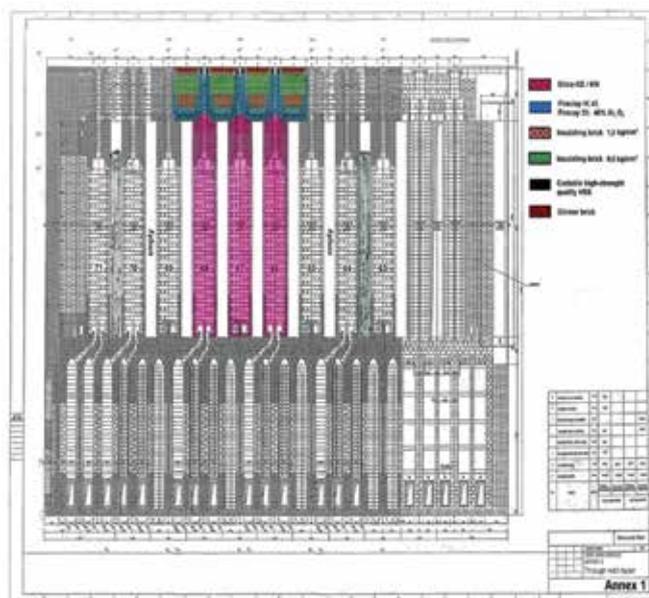


Fig. 4: Repair breaklines for a wall repair incl. roof area

Major factors for a successful repair are the continues temperature control and stability, comprehensive insulation of the remaining silica brickwork, the right bracing system to avoid static instabilities as well as a careful demolition of the brickwork and professional rebricking against hot face brick surfaces.

The masons must be capable to work in these tough conditions with highest accuracy.

A close coordination with the operator is required to coordinate the pushing schedules, the temperature distribution and the operation planning to ensure the availability of the working area.

If the refurbishment will start in good time the lifetime of the battery can already be extended for minimum 10 years and a second repair can extend the lifetime for additional minimum 10 years.

All this for 1/3 cost of a new battery.



Fig. 5: Constitution of heating wall before and after a repair

Subscribe in Print & Digital



Never Miss An Issue

www.isrinfomedia.com