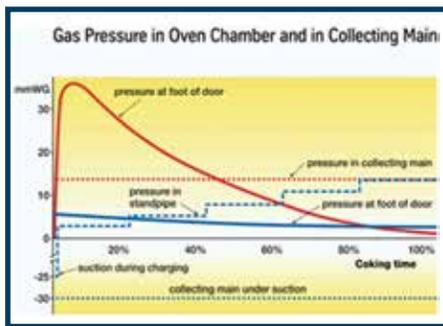


# The Latest Developments on the EnviBAT™ Pressure Regulation System

## INTRODUCTION

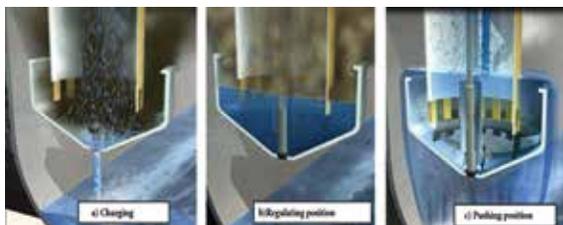
In the last 15 years, India has seen a phenomenal growth in terms of adding steel capacity most of which have been added through Blast Furnace route thus adding approx. 12-15 Mn Tons New Coke capacity.

With the VISION of Indian Government to add more and more steel-making ca-



capacity in coming decades, it is inevitable to reach this VISION by adding new Coke Plants. This draws our attention towards a need for adopting stringent norms towards emissions than what are being currently followed in India, something that is also receiving increasing attention in recent times, with the Government of India specifying emission norms from steel plants.

Critical Emissions from Coke Oven Plant are of two types i.e. fugitive emissions and emissions during charging / pushing. While there are technologies



EnviBAT™ Pressure Regulation System—most important regulating positions.

already being used by Indian companies to reduce emissions during charging / pushing, most of the steel plants are doing little to control fugitive emissions.

A fundamental solution to minimize fugitive emissions is the EnviBAT™ Pressure Regulation System. The EnviBAT system is based on an innovative collecting main valve and regulates the pressure in individual coking chambers at a constantly low level.

The article will treat the latest development and possibilities on the EnviBAT™ Pressure Regulation System. Dependent on the clients' demands either an integrated or a modular solution is available for the configuration of the EnviBAT system in a coking plant.

Due to continually increasing demands for the environmental restrictions imposed by developing countries, new technologies should also be adopted and implemented by steel plants especially, when it comes to fugitive emissions from oven. Several techniques and its progress towards the sustainable development are now widely used worldwide to reduce fugitive emissions from coke oven closures. An advanced solution to overcome this problem is an individual chamber pressure regulation system.

Until today a coke production of more than 30 Mio t per an now as realized or is under construction world wide using the EnviBAT system:

- 15 coke oven batteries in China
- 11 coke oven batteries in South Korea
- 7 coke oven batteries in Brazil
- 1 coke oven battery in the USA

## Mining the thyssenkrupp expertise bank

Starting this issue, we bring you a series of articles written by experts of thyssenkrupp on Coke Ovens and related fields. 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. All 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, please email : amit.mainde@thyssenkrupp.com

- 4 coke oven batteries in Germany
- 1 coke oven battery in Canada

At any given point of time, pressure inside individual ovens is different since they are at different stages of coking periods. It is a known fact that ovens that are recently charged witness highest pressure while ovens that are nearing their coking time witness lowest pressures. This has following effects:

- Ovens at a higher pressure in comparison to gas collecting main are more prone to have fugitive emissions
- Adjacent ovens operating at different pressures have different levels of stress on the oven chamber walls thus, reducing the refractory life significantly.

In order to overcome above mentioned

serious issues it is important to regulate pressures in individual ovens so as to maintain a slightly negative pressure throughout the coking period. This can be easily achieved by installing EnviBAT™ Pressure Regulation System on new or old coke oven batteries.

Following illustration provides you graphical representation of pressure within individual oven during entire coking period. In addition, it also compares the pressure within individual ovens after installation of EnviBAT™ Pressure Regulation System.

EnviBAT™ Pressure Regulation System is able to manage all necessary actions during a complete coking time. In the following, the three most important regulating positions of the system during the coal carbonization cycle are illustrated in Figure 2.

The EnviBAT system includes new gas collecting main with a water filled Fix-Cup inside GCM, crown tube with calibrated slots cut into its end, the overflow regulation device, the pressure controller and fast flooding pipe (Figure 1).

## Development of the EnviBAT™ Pressure Regulation System

The primary aim of EnviBAT system is to constantly improve environmental-protection and plant safety. In the last years tkIS has implemented several process-technological and constructional innovations into the system:

### Replacement of the seal ring-high temperature silicon with the compensator solution

The connection between gas collecting main (GCM) and goose neck is sealed-gas-tight by a dip pipe sealing to wards the atmosphere. Through this connection the expansion movement in vertical and



EnviBAT™ Pressure Regulation System- Arrangement Schem at ic and components.

horizontal direction can be absorbed. In order to achieve further performance improvement of the system, cost savings in planning and control and at the same time to fulfill the customer demands, it was necessary to continue the development of the design. One of the last innovations is the replacement of the still successfully applied dip pipe sealing (seal ring with high temperature silicon) with a compensator.

Figure below shows the new compensator solution vs. sealing with high temperature silicon in Hyundai Steel Co., Battery 6, South Korea. The most important benefits of this solution are:

- The FixCup and crown tube belong to a one component assembly – the expansion of the oven top has no influence on the springs fixed to the EnviBAT™ Pressure Regulation System cylinder, these

do not have to be readjusted during operation,

- The Fix Cup, crown tube and cylinder axis ensure a straight inlet of the plug with overflow regulation device in the drain hole in the Fix Cup,
- High-duty system providing maximum reliability with lower maintenance
- Cost reduction
- The new compensator solution ensures improved security and life duration

### Piston rod sealing system - modified design of the dip pipe sealing

The regulating device of the EnviBAT system is actuated by a pneumatic cylinder via the piston rod (see Figure below). The cylinder is mounted outside the gooseneck. To avoid emissions where the piston rod is ducted through the goose-



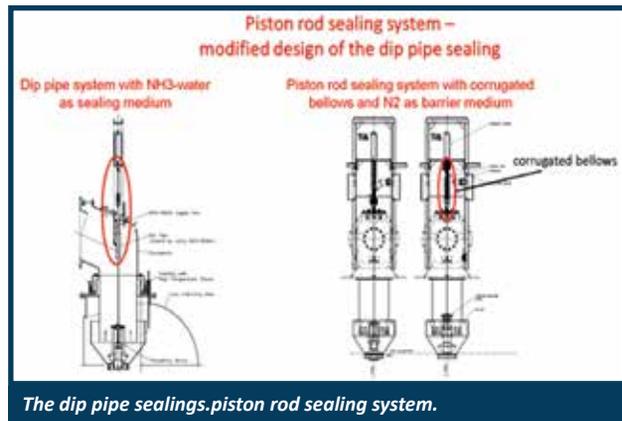
The new compensator solutions. dip pipe sealing in Hyundai Steel Co., Battery 6, South Korea.

neck, a water sealing system in combination with the dip pipe is installed. To reduce the consumption of flushing liquor in the raw gas system, tkIS designed a new way of emission free sealing at the piston rod, which is patent-registered. The sealing of the piston rod is achieved by the new corrugated bellows, which is installed instead of the fluid dip pipe (see Figure below). The corrugated bellows should be purged in order to avoid formation of condensing raw gas.

The practical tests at Hyundai Steel Co. the compensator solution and the calculation regarding dip pipe modification have shown that the flushing liquor consumption has been reduced significantly.

**The most important advantage of the piston rod sealing system is:**

- Significant reduction of the flushing liquor consumption,
- No dip pipe in the gas flow generates lower maintenance (cleaning) work at the



goose neck sand increases the flexibility of the piston rod and reduces possible jamming,

- Increasing retention time in the decanter of the by-product plant by retro fitting of existing plants,
- Significantly improved NH3 water quality,
- Reduced electrical consumption by retro fitting of existing plants, reduced maintenance of the pumps, higher avail-

Important components	EnviBAT™ Pressure Regulation systems	
	Integrated solution	Modular solution
GCM	New collecting main	Existing collecting main
Old GCM valve	Not necessary	Remains in place
Position of FixCup	Inside the GCM, replacing the conventional GCM	Above the GCM in the modular housing
Crown tube	a pipe with calibrated slots cut into it send, fitted to the down stream end of the stand pipe elbow	
Over flow regulation device	comprising of the regulation part for the water level and the plug for the drain hole in the FixCup	
Pressure controller	controlling the position of the pneumatic cylinder for the actuation of the over flow regulation device	
The fast flooding pipe	supplies ammonia liquor to quickly fill the Fix Cup in case the oven is to be disconnected from the gas collecting main	
Electro-Pneumatic Cabinets & new 4/3-way valves	<ul style="list-style-type: none"> <li>• Provides flexibility between automatic and manual mode of operation.</li> <li>• No external Remote I/O cabinet necessary, therefore easier &amp; faster installation.</li> <li>• Manually operated 4/3-way valve for operating (if power or signal loss) or blocking (maintenance work with improved safety) of the EnviBAT control cylinder.</li> </ul>	

*Comparison of the integrated and modular solution of the EnviBAT™ Pressure Regulation system*

ability of the pumps, system:

- Reduced maintenance of flushing liquor filters,
- Reduced blocked or overflowing dip pipe sand deposits of the outside of the goose neck,
- Reduced emissions through gas-tight sealing of the piston rod,

- Cost reduction,

**POSSIBILITIES FOR THE CONFIGURATION OF THE ENVI-BAT™ PRESSURE REGULATION SYSTEM**

Meanwhile there are basically 2 technical possibilities for the configuration of the

An integrated solution consisting of the Fix Cup, crown tube and the overflow regulation devices installed inside of the gas collecting main, which can be implemented either by the erection of a complete new coke oven plant or combined with the exchange of an existing GCM at an existing coke plant.

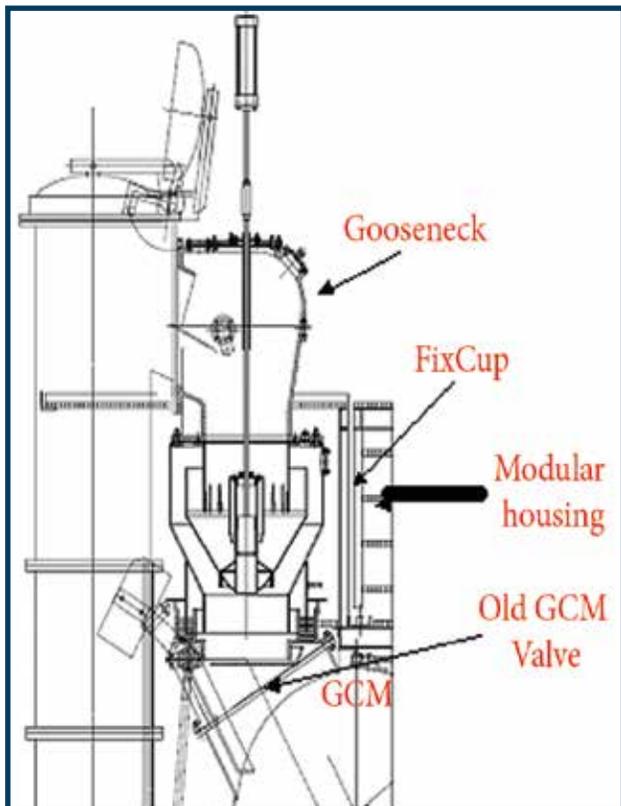
2. A newly developed modular solution consisting of a modular housing in addition to the FixCup, crown tube and overflow regulation devices (see Figure 6), which allows an installation of EnviBAT™ Pressure Regulation System outside of the GCM - on the top of the GCM without removal of the existing conventional GCM valve during a retro fit installation. The modular solution fulfills the process with the same components and functions as the integrated solution.

From these possibilities for the configuration of the EnviBAT™ Pressure Regulation System three different applicable



Following shows both new developments: the piston rod sealing system and the compensator solution.

options for implement at ionin a coke plant are available–dependent on the clients’ demands(see Figure7):



1. For New Coke Plants–For thee rection of a new coke plant the EnviBAT™ Pressure Regulation System is integrated from the beginning of the planning until the final realization as one (of the many)technical features/ component sin the new plant.

2. For Existing Coke Plants– Many customers have used the possibility to improve the environmental compatibility of the irexisting plant by installation of the EnviBAT™ Pressure Regulation System. There are 2sub-options for retro fitting existing batteries with EnviBAT™ system:

2.1. Combined installation of EnviBAT™ Pressure Regulation System and a new GCM

Most of the EnviBAT™ Pressure Regulation System retrofit-installations have been combined with the exchange of an existing more or less damaged GCM, a combination whichisal-socost saving for the customer. In this case the complete GCM is pre fabricated, mounted and the EnviBAT™ Pressure Regulation System components are integrated; there afterthe complete GC-M+EnviBAT™ system was taken into operation as a whole.

2.2. EnviBAT™ Pressure Regulation System installation without exchange of the GCM

However, in some cases the existing GCM was in a quite good condition such that an exchange for technical

and economic reasons would be not reasonable.This type of installation can be performed during normal operation of the battery. The ovens can be equipped withthe new EnviBAT™ Pressure Regulation System step by step without setting thecomplete GCM out of operation.

## CONCLUSIONS

By application of the EnviBAT™ Pressure Regulation System fugitive emissions from the closure soft radicalional coke oven batteries can be minimized. Therefore even the most stringent environmental requirements can be met.EnviBAT™ system can be installed on new batteries as well as retrofitted on existing batteries. In a world where environment protection is above all priorities, it is important that steel makers realise that fugitive emissions should be controlled with best available technologies in the market and create a clean environment for their employees, families and largely the community around.

## REFERENCES

- /1/ H.J. Giertz, F. Huhn, K. Hofherr; Ironmaking Conf. Proc.54, 1995, pp439-445
- /2/ B.Wemhöner, J.Spitz, K.Hofherr, H.J. Giertz, F. Liesewitz, F.Huhn, Proc. 4th European Coke and Ironmaking congress, Vol.2, 19.-22.Juni2000, Paris, Frankreich, pp470-474.
- /3/ Industrial Emissions Directive 2010/75/EU.
- /4/ F. Huhn, F. Krebber, J. Kühn-Gajdzik, Stahl & Eisen; 131(2011)1;pp31-40.
- /5/ J. Kühn-Gajdzik, F.; Krebber,K. Überschar, J. Huhn,Stahl & Eisen; 134(2014)10; pp37-42.
- /6/ F. Huhn, F. Krebber, M. Reinke, H. Schulte, MPT 4/2010,pp26-29.