

Installation of the Pressure Regulated Oven (PROven) system at existing coke plants - an effective measure for the reduction of coke oven emissions

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INTRODUCTION

The risk of fugitive raw gas and dust emissions during the coking process has made coking plants an environmental challenge. Such emissions may take place on all openings of the battery as for example:

- during the oven charging at the charging holes,
- during the leveling at the leveler doors,
- during the whole coking time at oven doors, standpipe lids and charging holes.

There are many reasons for the emissions like incompletely sealed oven closures, an insufficient suction created by the high pressure liquor or charging steam system or an inadequate control of the gas collecting main pressure (GCM). In the past, some of these problems have been identified and solved, but a totally emission-free coke oven battery was never achieved in the conventional coking process because of the inseparable relationship between pressure in the GCM and the pressure in all of the connected chambers.

An advanced solution is the application of the pressure regulation system PROven that reduces the emissions from coke ovens causally. This allows the pressure in each individual oven chamber to be adjusted as a function of the actual raw gas production during carbonisation time, providing the optimum pressure level for the given coking condition. PROven is one of the most significant innovations in modern by-product coke making technology.

The basic system was developed and tested by DMT in the 90's. First industrial applications in the past were performed at the old August Thyssen coke oven batteries No.3 (35 ovens, 3.5m high) and 6b (52 ovens, 6m high). ThyssenKrupp Industrial Solutions (TKIS) (former Uhde) has implemented several process technological and constructional innovations into the system. The technology can be applied to coke ovens of most types and sizes in the world – from small 4m ovens up to 8m high capacity ovens. In 2003, it was installed in 2x70 ovens (8.4 m high) at the world's largest new coke oven plant, the

Schwelgern plant in Duisburg/Germany. Until today a coke production of more than 30 Mio t per anno was realized worldwide using the PROven™ technology:

- 13 coke oven batteries in China
- 11 coke oven batteries in South Korea
- 6 coke oven batteries in Brazil
- 1 coke oven battery in the USA
- 4 coke oven batteries in Germany
- 1 coke oven battery in Canada

TECHNICAL DESCRIPTION

PROven system is based on a new collecting main valve type by means of which the pressure in each oven chamber can be kept on a freely selectable low level. The most important components of the PROven system are (see Figure 1):

- The FixCup, a water-filled cup inside the GCM, replacing the conventional flap in the goose neck,
- The crown tube, being a pipe with calibrated slots cut into its end, fitted to the downstream end of the standpipe elbow. The water level in the FixCup is used for partly or completely closing the slots at the end of the crown tube.
- The overflow regulation device, comprising of the regulation part for the water level and the plug for the drain hole in the FixCup. This device is actuated by a pneumatic cylinder.
- The pressure controller, controlling the position of the pneumatic cylinder for the actuation of the overflow regulation device.
- The fast flooding pipe which supplies ammonia liquor to quickly fill the FixCup in case the oven is to be disconnected from the gas collecting main.

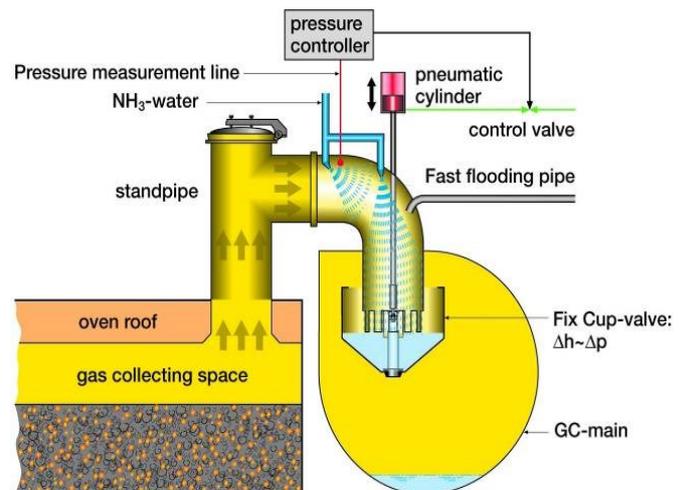


Figure 1 Schematic of the PROven system

OPTIONS FOR THE CONFIGURATION OF PROven

For the configuration of PROven three different applicable options are available - dependent on the clients' demands.

New Coke Plants

For the erection of a new coke plant the PROven system is integrated from the beginning of the planning until the final realization as one (of the many) technical features/components in the new plant. Examples for this type of configuration are 28 coke oven batteries at Schwelgern, HKM – Germany; POSCO Pohang, POSCO Gwangyang, HYUNDAI - South Korea; TISCO, Shougang, Shagang, Magang, Wuhan – China; USS Clairton – USA; .

Existing Coke Plants

Many customers have used the possibility to improve the environmental compatibility of their existing plant by installation of PROven. Examples for this type of configuration are 8 coke oven batteries at August Thyssen – Germany, CST and CSN – Brazil, Essar Algoma – Canada. There are 2 sub-options for retrofitting existing batteries with PROven:

Combined installation of PROven and a new GCM

Most of the PROven retrofit-installations have been combined with the exchange of an existing more or less damaged GCM, a combination which is also cost saving for the customer. In this case the complete GCM is prefabricated, mounted and the PROven components are integrated; thereafter the complete GCM+PROven system was taken into operation as a whole.

PROven installation without exchange of the GCM

However, in some cases the existing GCM was in a quite good condition such that an exchange was not necessary. A similar case is the exchange of only a single gooseneck which sometimes has to be performed because of damage or other reasons.

The biggest example for this type of installation is the August Thyssen battery no. 6b that consisted of 52 ovens, 6m tall and was operated successfully using PROven from 1999-2003.

For all these installations TKIS has taken care that the connection between the oven and the GCM (via standpipe and gooseneck) can be realized by the operating staff without interrupting the battery operation. The mounting procedure needs a certain logistics (organization of crane etc.), but is an inherent part of conventional maintenance; which is described in TKIS's maintenance manual for each plant.

Another option for the customer is a new modular solution (see Figure 2) developed by TKIS which

allows an installation of PROven outside, on the top of the GCM without removal of the existing conventional GCM valve during a retrofit-installation. This arrangement has the advantage of a simplified mounting procedure during which the conventional GCM valve flap can be held closed. Therefore all mounting steps for the PROven components can be handled easier. After completion of the mounting the old GCM valve flap is opened again. An additional advantage is that the modular PROven system construction is insensible to any movement or expansions of the battery due to the concentric arrangement of all control devices.

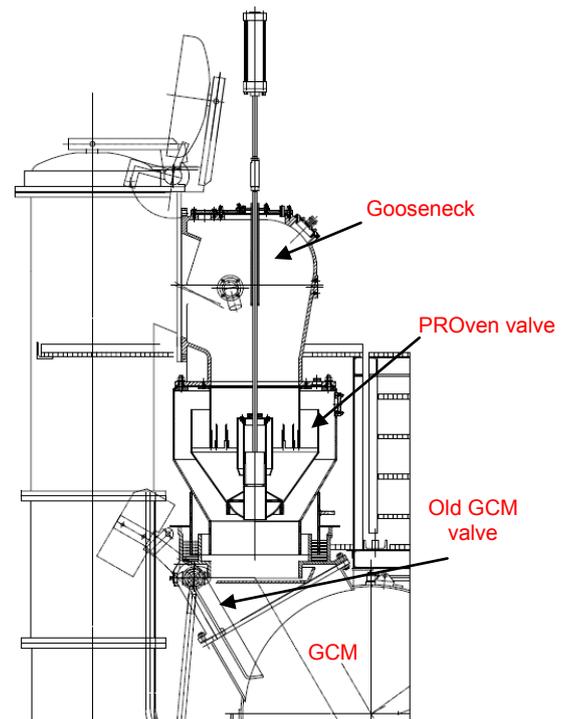


Figure 2 New modular PROven system

SUMMARY

By application of the pressure regulation system PROven traditional coke oven batteries can be operated nearly emission free. Therefore even the most stringent environmental requirements can be met.

ThyssenKrupp Industrial Solutions (TKIS) is in the position to supply PROven in all relevant/different configurations for a customer:

- in combination with a complete new battery,
- for existing coke plants in combination with an exchange of the GCM,
- for existing coke plants without changing the existing GCM,
- for all configurations the new modular PROven system.