The latest developments on the EnviBAT™ Pressure Regulation System

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Introduction

1. Motivation

2. EnviBat™ Pressure Regulation System
   - Motivation
   - History – Track record
   - Function
   - Technical description
   - Constructional innovations and developments

3. Option for the configuration of Pressure Regulation System

4. Summary
EnviBat™ Pressure Regulation System

Motivation - Emissions

Diffuse Coke Oven Plant Emissions
- occurring
- During oven charging at the charging holes
- During leveling at the leveler doors
- During the whole coking time at all oven closures

caused by
Inadequate control of the GCM pressure
- Insufficient suction by the high pressure liquor or charging steam system
  - Leakages at all oven closures

can be avoided by use of a
Pressure Regulation System
Invention and Development of a System to Control the Pressure in Each Single Oven by DMT, Germany, known as PROven*-System,

* PROven is a registered trademark of TÜV NORD AG and it is still used by DMT GmbH & Co.KG.

- Exclusive License Agreement between DMT and TKIS from 1998 – 2014,
- First industrial implementation of the System at battery 6B of the Coke Oven Plant August Thyssen in 1999
- Development of the enhanced Overflow Regulation System and further improvements by TKIS since 2001
- Installation of the enhanced System at the Coke Oven Plant Schwelgern and all following plants – now under the brand name "EnviBat™ Pressure Regulation"
- Until today at 36 batteries worldwide
4 coke oven batteries in Germany
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
1 coke oven battery in Canada

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World wide today

Schwelgern, Germany
POSCO / Gwangyang, South Korea
Hyundai Steel Co. - South Korea
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- Oven pressure as a function of the actual raw gas production
- Low pressure at the beginning of carbonization prevents emissions
- Increasing pressure at the end of the coking time prevents air ingress
- Suction in the GCM (-3.5 to -2.5 mbar) allows unsurpassed exhaustion of the charging gases
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Technical description

Arrangement Schematic

FixCup in GCM

Overflow regulation device

Control device at the gooseneck
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Charging position

Control position

Pushing position
oven disconnected
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Further developments

Adaptation for small and medium-sized coke ovens

Test rig for small-sized coke ovens

Implementation of the Pressure Regulation System
5 m battery, Essar Algoma plant in Canada
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Further developments

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

Hyundai Steel Co., Battery 6, South Korea
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Further developments

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

The most important benefits:
- No readjustment during operation,
- The FixCup, crown tube and cylinder axis ensure a straight inlet of the plug with overflow regulation device in the drain hole in the FixCup,
- Maximum reliability with lower maintenance,
- Improved security and life duration,
- Cost reduction.
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Further developments

Piston rod sealing system – modified design of the dip pipe sealing

Dip pipe system

Piston rod sealing system
Situation (Cylinder Plugged out)

Piston rod sealing system
Situation (Cylinder Plugged in)
EnviBat™ Pressure Regulation System

Further developments

Piston rod sealing system – modified design of the dip pipe sealing

The most important benefits:

- Significant reduction of the NH₃ consumption,
- Significantly improved NH₃ water quality,
- Lower maintenance work at the goosenecks,
- Flexibility of the piston rod and reduces possible jamming,
- Reduced blocked or overflowing dip pipes and deposits of the outside of the gooseneck,
- Reduced emissions through gas-tight sealing of the piston rod,
- Cost reduction.
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Further developments

New modular system

<table>
<thead>
<tr>
<th>Important components</th>
<th>EnviBAT™ Pressure Regulation systems</th>
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<td></td>
<td>Integrated solution</td>
</tr>
<tr>
<td>GCM</td>
<td>New collecting main</td>
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<tr>
<td>Old GCM valve</td>
<td>Not necessary</td>
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<tr>
<td>Position of FixCup</td>
<td>Inside the GCM, replacing the conventional GCM valve</td>
</tr>
<tr>
<td>Crown tube</td>
<td>a pipe with calibrated slots cutted into its end, fitted to the downstream end of the standpipe elbow</td>
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<tr>
<td>Overflow regulation device</td>
<td>comprising of the regulation part for the water level and the plug for the drain hole in the FixCup</td>
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<td>Pressure controller</td>
<td>controlling the position of the pneumatic cylinder for the actuation of the overflow regulation device</td>
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<td>The fast flooding pipe</td>
<td>supplies ammonia liquor to quickly fill the FixCup in case the oven has to be disconnected from the gas collecting main</td>
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EnviBat™ Pressure Regulation System

Further developments

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**EnviBat™ Pressure Regulation System**

**Further developments**

**New modular system**

The most important benefits:
- Improved and more service friendly option for the customer,
- Easy mounting procedure during which the conventional GCM valve flap can be held closed,
- Construction of the modular EnviBAT™ Pressure Regulation System is insensible to any movement or expansions of the battery due to the concentric arrangement of all control devices; no re-adjustments required during operation.
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Options for the configuration

Configuration

Coke Oven Batteries

New Coke Plants

- 28 coke oven batteries:
  - at Schwelgern, HKM – Germany;
  - POSCO - Pohang, POSCO Gwangyang, HYUNDAI - South Korea;
  - TISCO, Shougang, Shagang, Magang, Wugang – China;
  - USS Clairton – USA

Existing Coke Plants

- 8 coke oven batteries

Combined installation of the system and a new GCM

- CST and CSN – Brazil,
  - Essar Algoma – Canada

Installation without exchange of the GCM

- August Thyssen – Germany
  (in cooperation with DMT)
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Summary

The presented new solutions:
- Compensator solution,
- Piston rod sealing system,
- New modular system

can be taken into operation without any limitations.

These new solutions generate:
- the significant cost reduction,
- the simple maintenance,
- the long life duration.

TKIS is in the position to supply the EnviBAT™ Pressure Regulation System in all relevant configurations for a customer:
- the integrated solution in combination with a complete new battery or,
- the integrated solution for existing coke plants – preferably in combination with an exchange of the GCM,
- the new modular solution for existing batteries without a need for changing the existing GCM.
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