First operational experiences of the next generation PROven® system at a Coke Plant - “PROven® NG”

Dr. Frank Sowa
Head of Cokemaking Engineering
DMT GmbH & Co. KG, Essen, Germany
Pressure development during coking time at coke oven doors

![Graph showing pressure development over coking time with ideal pressure, high emissions, current practice adjustment, and low emission adjustment.]
Conventional operation: „on the main“ and „off the main“

Oven is „on the main“ ready for charging / coking process

- Goose neck
- Collecting main
- Flushing liquor
- Collecting main valve (opened)
- Standpipe lid is closed

\[ P_{\text{oven}} = P_{\text{collecting main}} \]

Oven is „off the main“ ready for pushing

- Collecting main valve (closed)
- Standpipe lid is opened

\[ P_{\text{oven}} = 0 \text{ mbar} \]

No oven pressure control during coking process.
The most important technological improvements of PROven®:

- The oven pressure is decoupled from the collecting main pressure.
- The collecting main operates with negative pressure.
- The pressure inside each oven is controlled individually.
- Charging gases are sucked off by negative collecting main pressure.
- With PROven® NG the conventional valve is replaced by a so called „Rotatable Cup“.
- The new rotable cup can be rotated like a „conventional valve“.
- The water level inside the new rotable cup is fixed (always in overflow mode).
- The crown pipe itself is moved to directly control the oven pressure!

*NG = Next Generation
PROven® NG:
Operation of the rotatable cup

Oven is „on the main“ ready for charging
\[ P_{\text{oven}} = P_{\text{collecting main}} \]
Crown pipe open; standpipe lid is closed

Oven pressure regulation during coking process
\[ P_{\text{oven}} \neq P_{\text{collecting main}} \]
Crown pipe moves in water; standpipe lid is closed

Oven is „off the main“ ready for pushing
\[ P_{\text{oven}} = P_{\text{atmosphere}} \]
Crown pipe dipped in water; standpipe lid is open
Operation at a single oven in a coke plant:

Retrofitting of PROven® NG to an old coke oven

**Battery data:**
- Age of battery: 25 years
- Number of ovens: 65
- Height of ovens: 5.5 m (30 m³ oven volume)
- 2 gas collecting mains

**Retrofit**
- **PROven® NG** has been mounted in between collecting main valve and standpipe basis (flange connection) under full operation basis
- Remote data acquisition installed
- Operation at +20°C (October ‘15) down to -15°C (January ‘16)
- Operation period: October 2015 to May 2016 (8 months without interruption)

**Typical PROven® NG Data**
- Liquor flow for water sealings: max. 600 l/h
Retrofit installation of PROven® NG to an old coke oven

Moved in 1 piece to battery top

PROven® NG still „at the hook“

Installation complete
Retrofit installation of PROven® NG to an old coke oven – after some months of operation
Gas pressure in coke oven (setpoint: 2.6 mbar)

Gas pressure in gas collecting main

Start: 12:48
End: 15:14
Pressure Control in coke oven – 02.02.2016

Gas pressure in coke oven (setpoint: 2.6 mbar)

Movement of crown pipe (Position in mm)

Start: 12:48
End: 15:14
Conclusions (1/3)

- The PROven® NG design is much simpler and more rugged compared to previous PROven® model.
  - The new crown pipe and rotatable cup are less prone to blockages than the previous drain valve in the FixCup.
    - The PROven® system has narrow clearance in some parts of the drain valve that can be blocked by deposits and reduces watertightness of the drain valve.
  - Permanent discharge of buoyant particles by continuous water overflow over the rim of the rotatable cup into the gas collecting main.
  - Bigger particles are swept out by rotating the new rotatable cup during pushing of the oven.
- No relative movement of the PROven® NG components, if the collecting main and the goose neck misalign.
Conclusions (2/3)

- The pressure control speed with PROven® NG is enhanced.
  - By moving the crown pipe up and down in the water of the rotatable cup the oven pressure control is fast and direct.
  - The pressure control is decoupled from the previous water level rise or fall (which is different in speed).

![Diagram of PROven® NG with small deflection of the crude gas and no turbulences of the crude gas.](image)
The dimension of the **PROven® NG** system is significantly smaller.

- Retrofitting with **PROven® NG** can be done without modification of the gas collecting main.

- Arrangement of the complete **PROven® NG** system outside the gas collecting main is possible.

- The water seal of the actuation rod is located outside the goose neck with **PROven® NG**, therefore less heat impact and direct accessibility for maintenance & visual control.
Success Stories – PROven® (Pressure Regulated Oven)

Installed by Uhde GmbH, Germany, under license of DMT for

- KBS Schwelgern, Germany
- Taiyuan Iron and Steel, China
- POSCO, Korea
- Ma Anshan, China
- CST, Brazil
- Hyundai Steel Company, Korea
- Shougang, China
- CSN, Brazil
- Shagang, China
- HKM, Germany
- Clairton, USA
- Algoma, Canada

PROven® is installed in more than 2100 ovens worldwide.
THANK YOU FOR YOUR ATTENTION!