

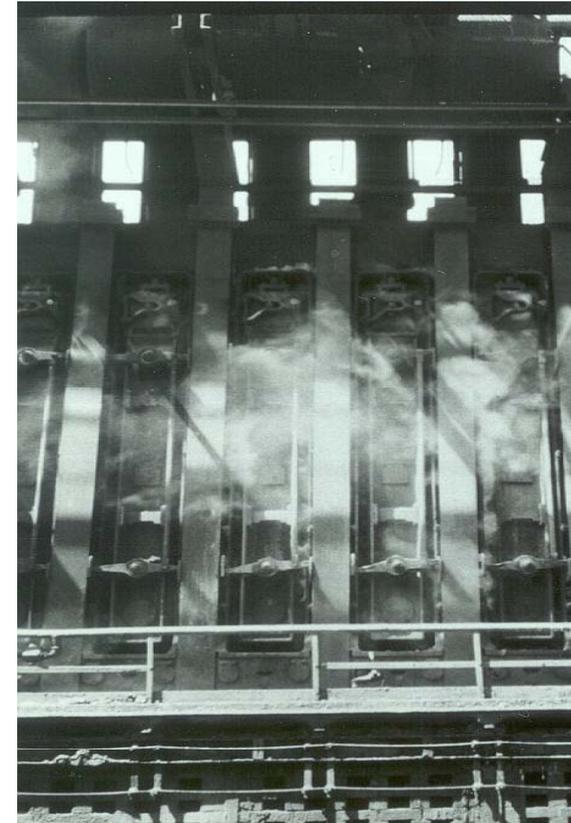
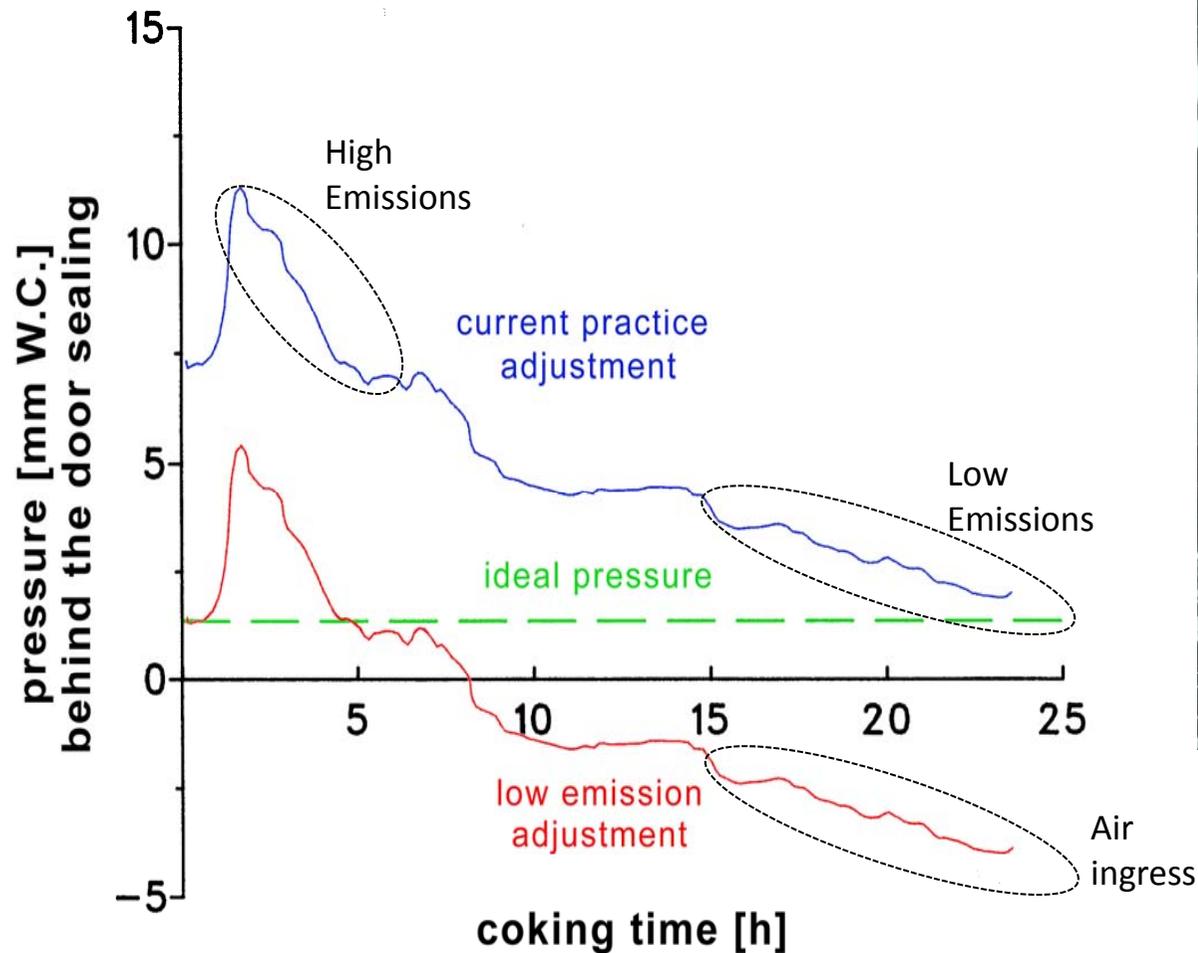
Coke Oven Pressure Regulation – The next generation PROven[®] system “PROven[®] NG”



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Head of Process Engineering
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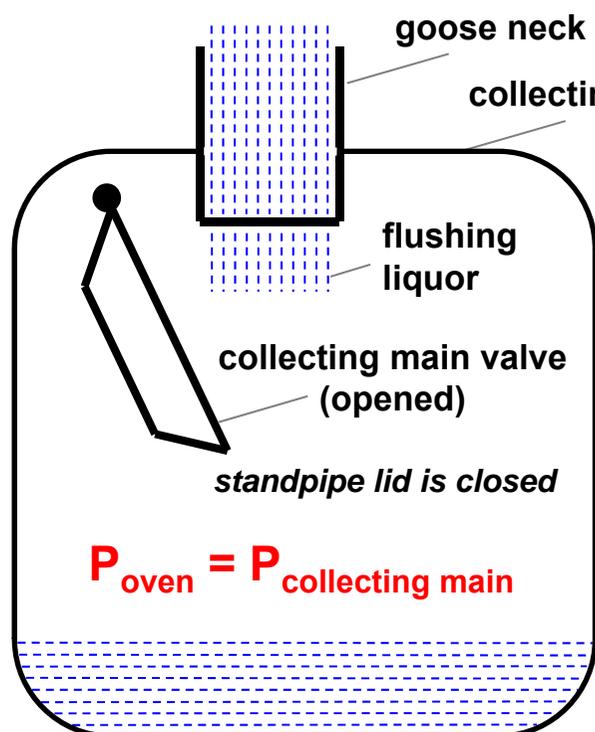
Pressure development during coking time at coke oven doors





Conventional operation: „on the main“ and „off the main“

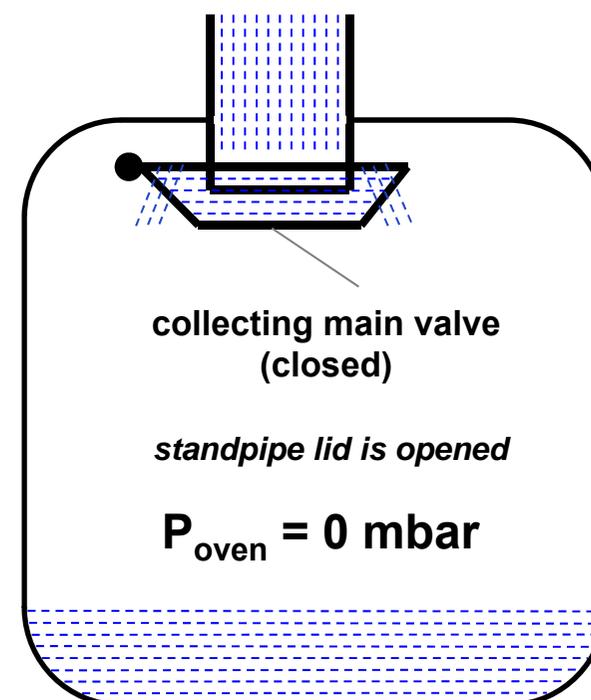
Oven is „**on the main**“
ready for charging / coking process



No oven
pressure control
during
coking process.



Oven is „**off the main**“
ready for pushing

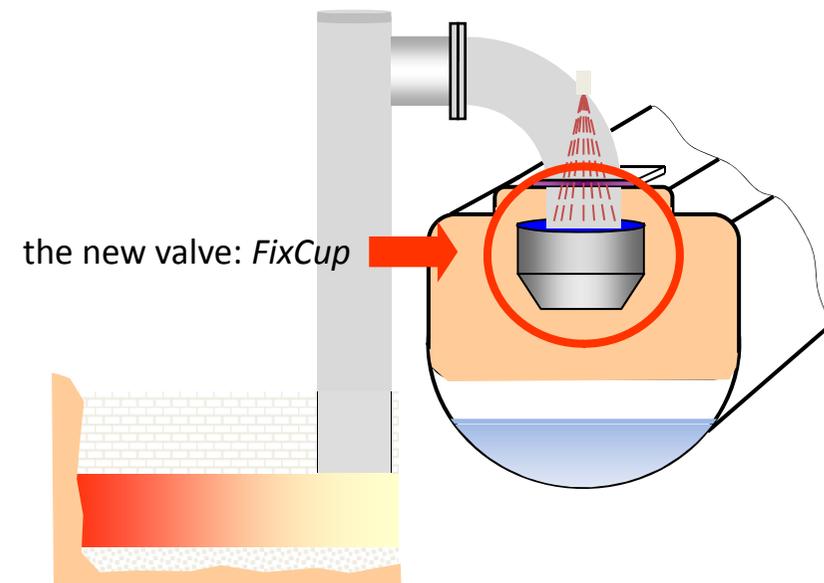
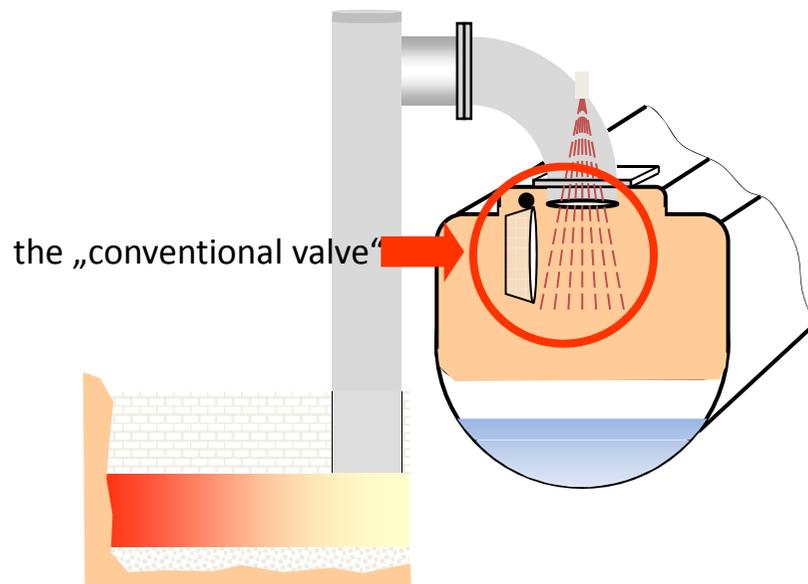




Some basics of PROven[®] - Pressure Regulated Oven

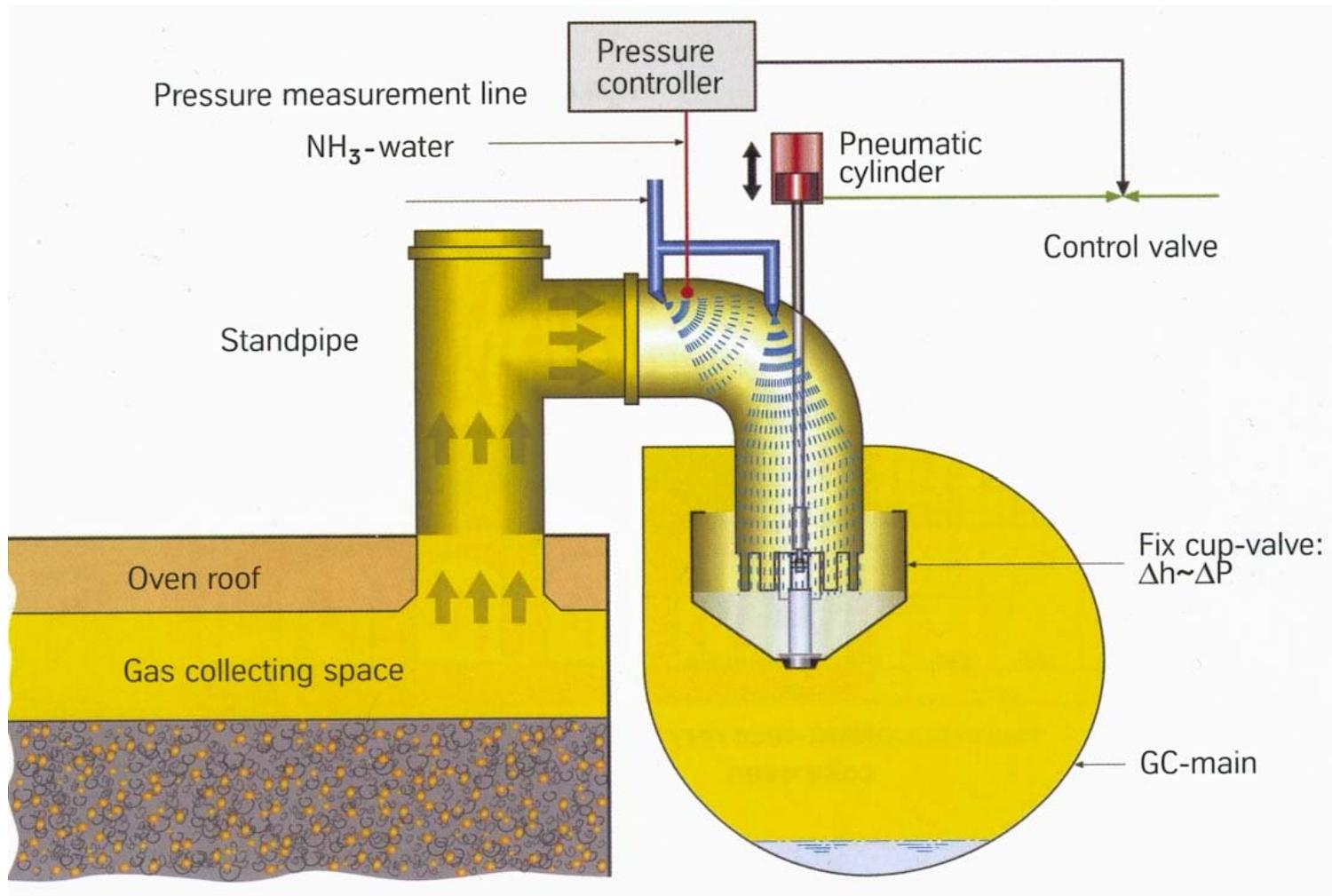
The most important technological improvements of PROven[®] :

- 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.
- The conventional valve is replaced by a so called „FixCup“.





The PROven[®] system

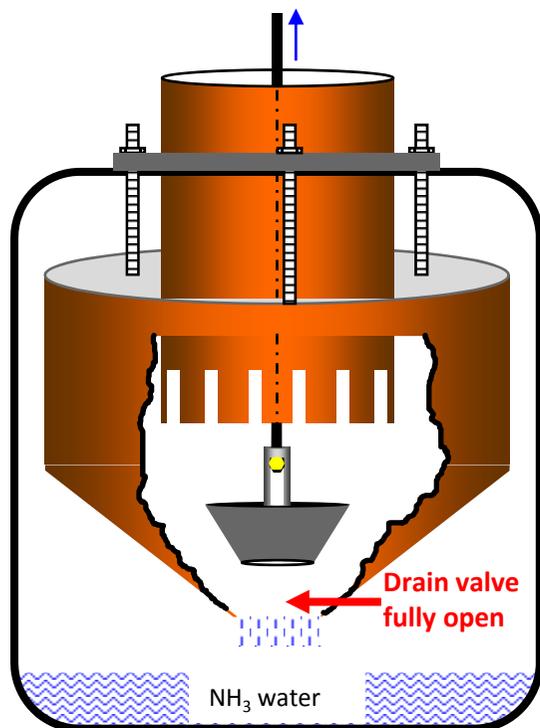




PROven[®] : Operation of the FixCup

Oven is „**on the main**“
ready for charging

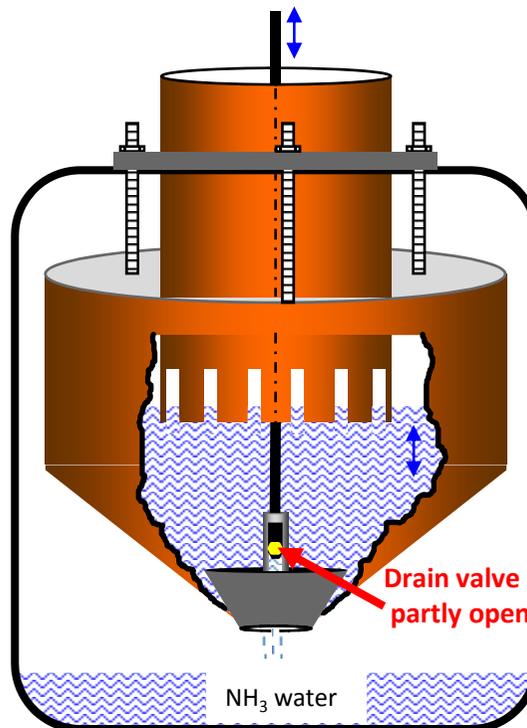
$$P_{\text{oven}} = P_{\text{collecting main}}$$



FixCup empty; standpipe lid is closed

Oven **pressure regulation** during
coking process

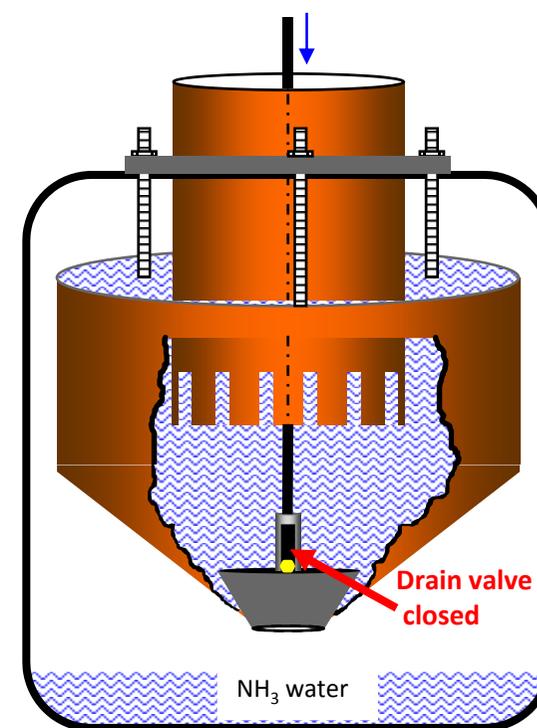
$$P_{\text{oven}} \neq P_{\text{collecting main}}$$



FixCup drain flow; standpipe lid is closed

Oven is „**off the main**“
ready for pushing

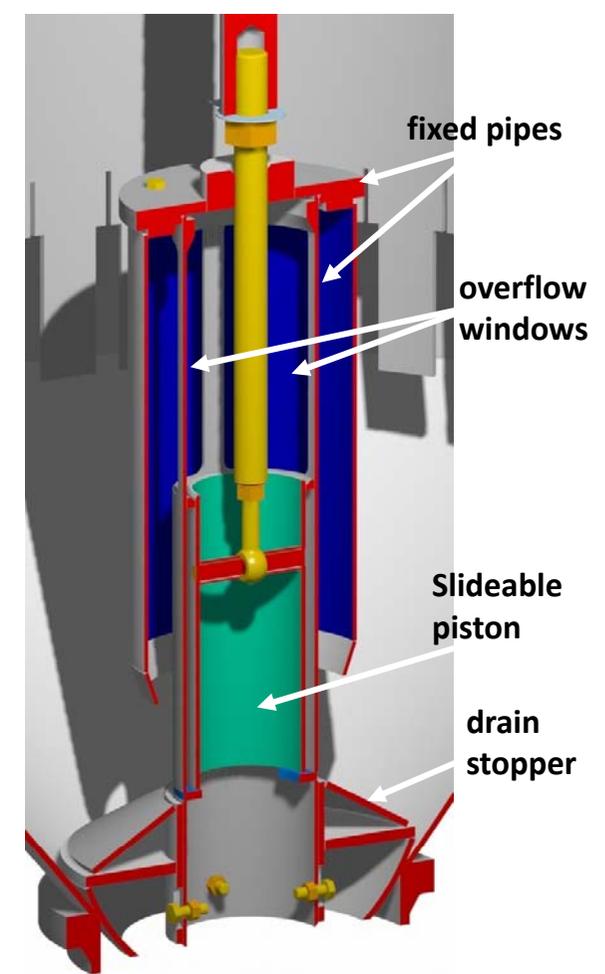
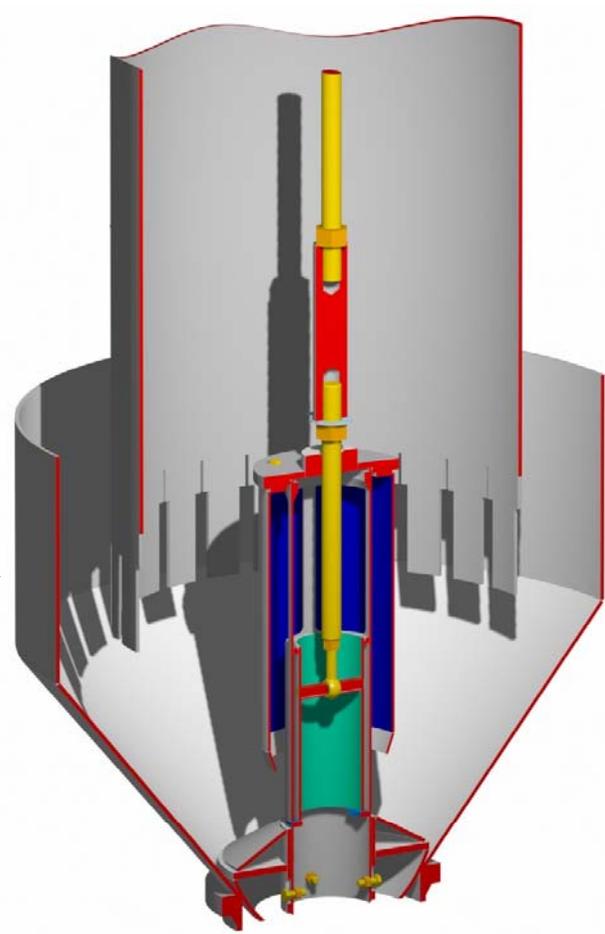
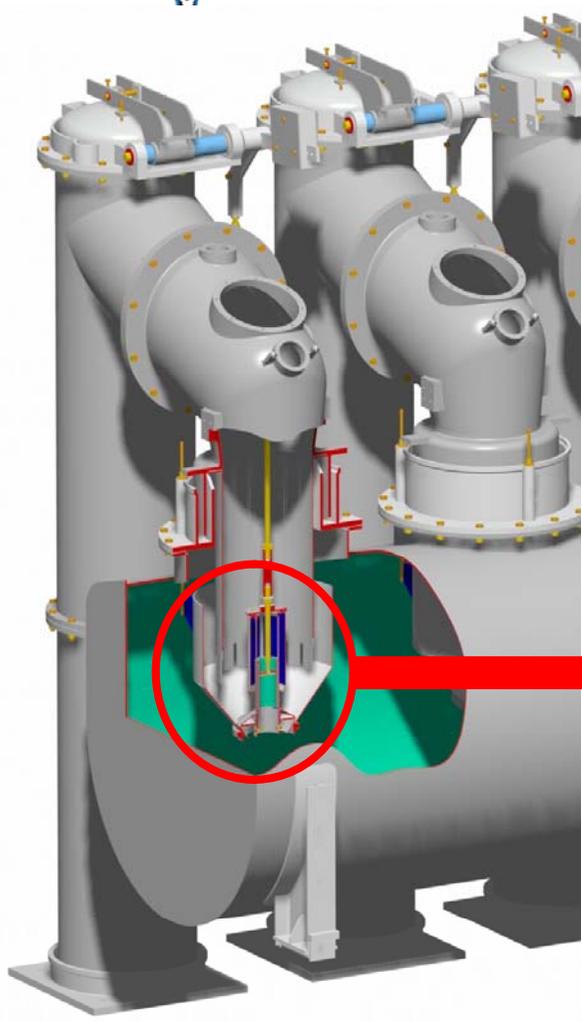
$$P_{\text{oven}} = P_{\text{atmosphere}}$$



FixCup overflow; standpipe lid is open

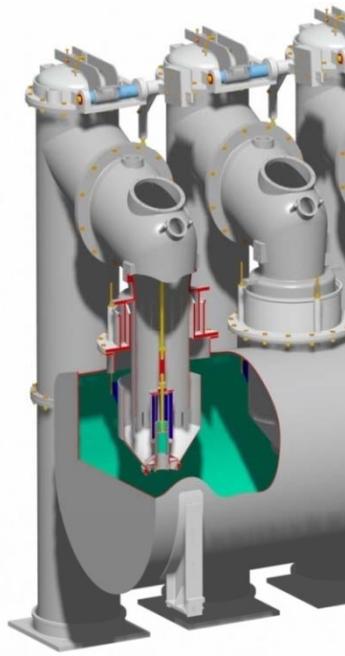


A closer look into the PROven[®] system





References – PROven[®] (Pressure Regulated Oven)



PROven[®]
a registered Trademark of
DMT GmbH & Co. KG



Installed by Uhde GmbH, Germany 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

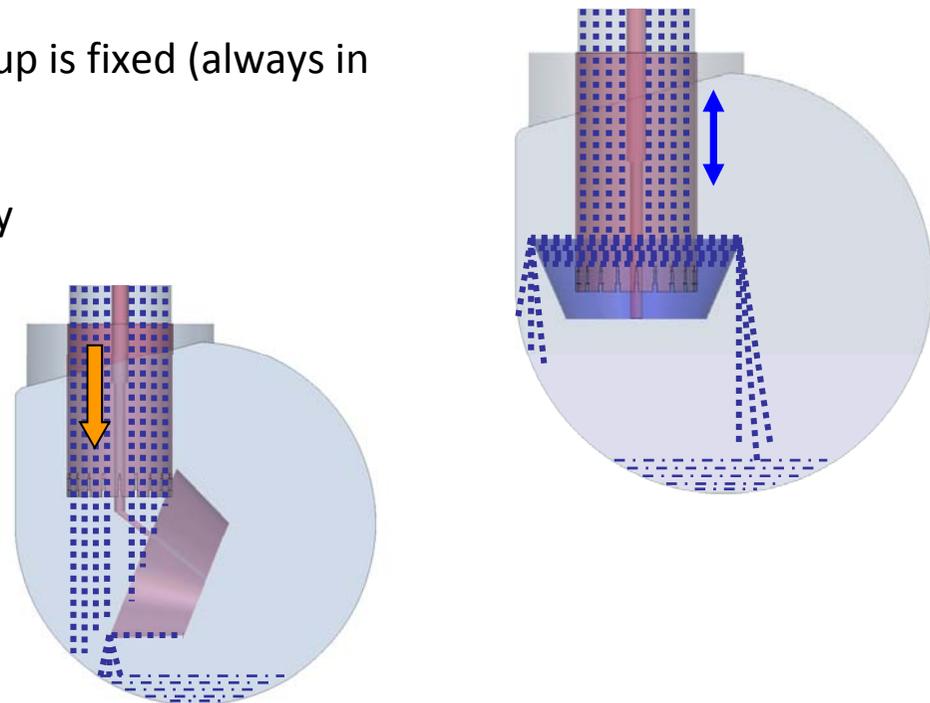
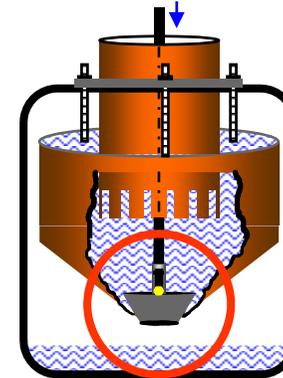
PROven[®]
is installed in more than 2100
ovens worldwide



The next generation of PROven[®] :

PROven[®] NG

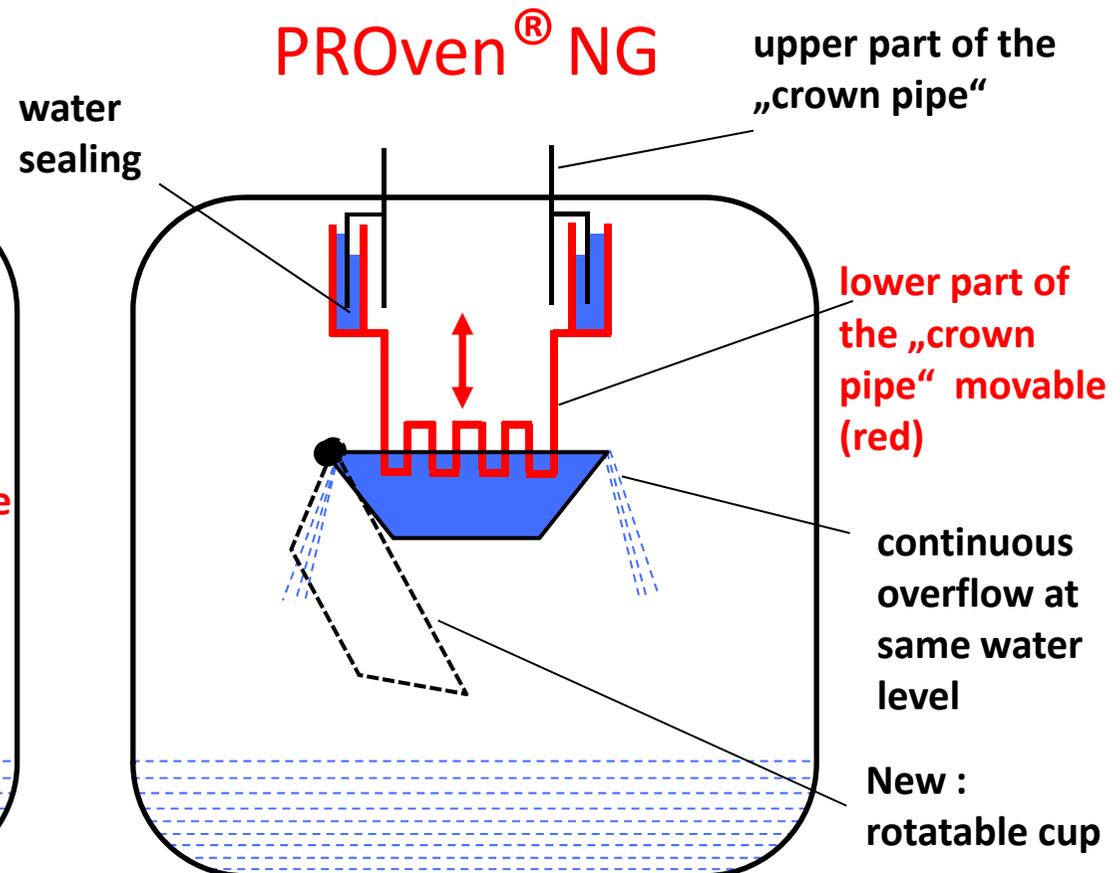
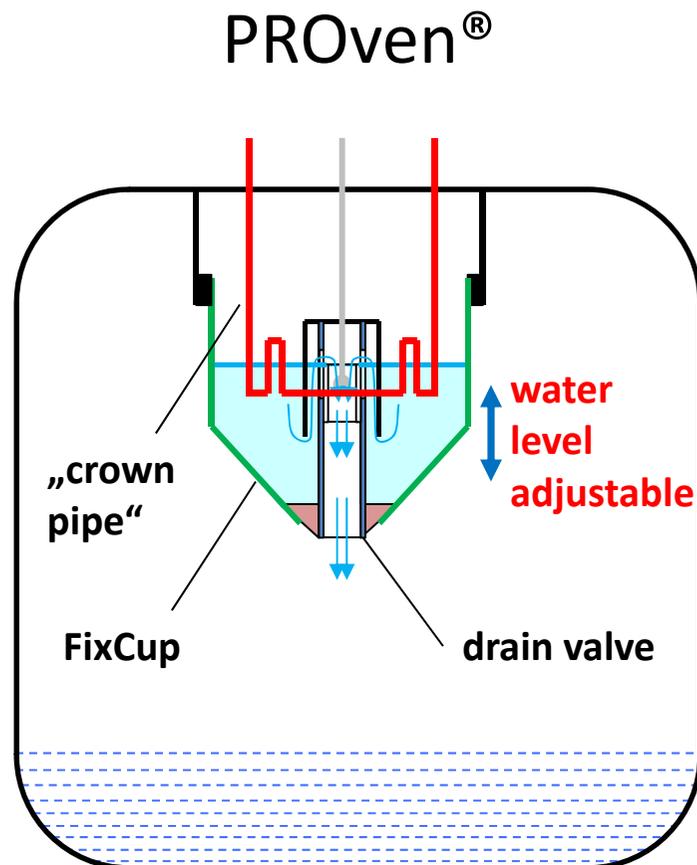
- The special drain valve is no longer necessary.
- A new rotatable cup is introduced replacing the FixCup.
- The water level inside the new rotatable cup is fixed (always in **overflow** mode).
- The crown pipe itself is moved to directly control the oven pressure!
- The new rotatable cup can be rotated like a „conventional valve“.





PROven[®] and PROven[®] NG :

Both systems in comparison (1/2)



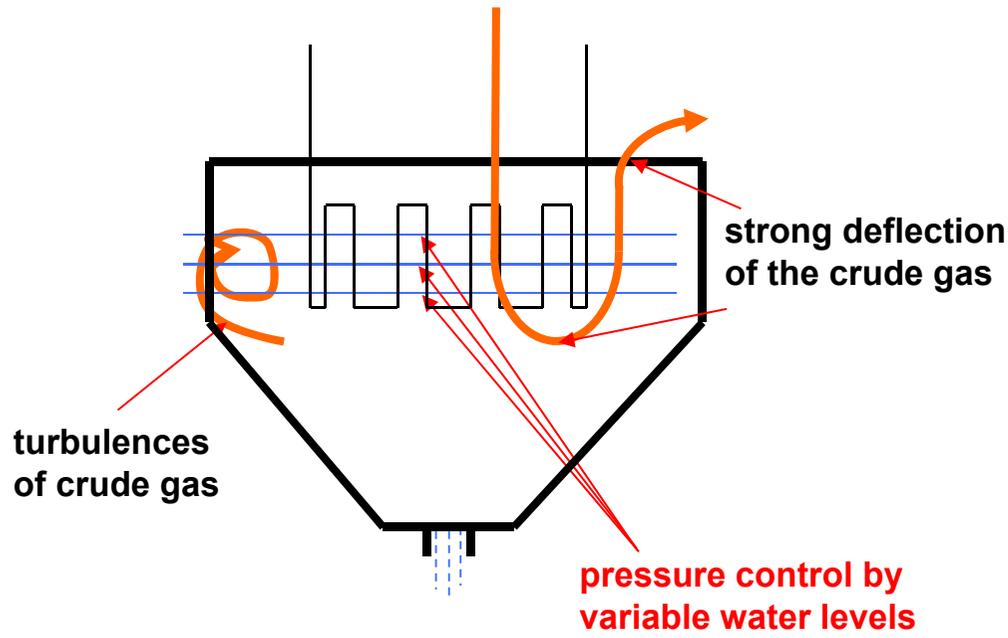


PROven[®] and PROven[®] NG :

Both systems in comparison (2/2)

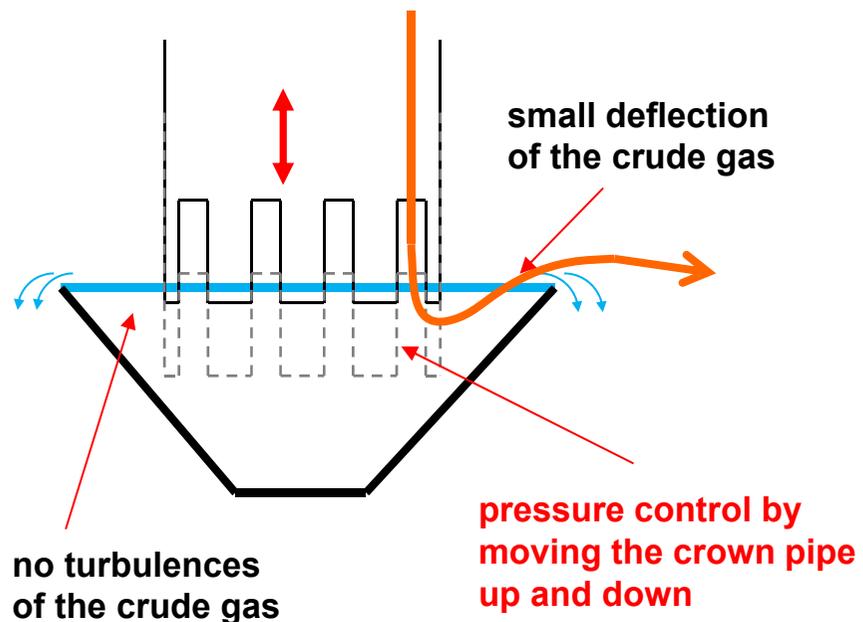
PROven[®]

(drain valve not shown here)



PROven[®] NG

(no drain valve necessary)



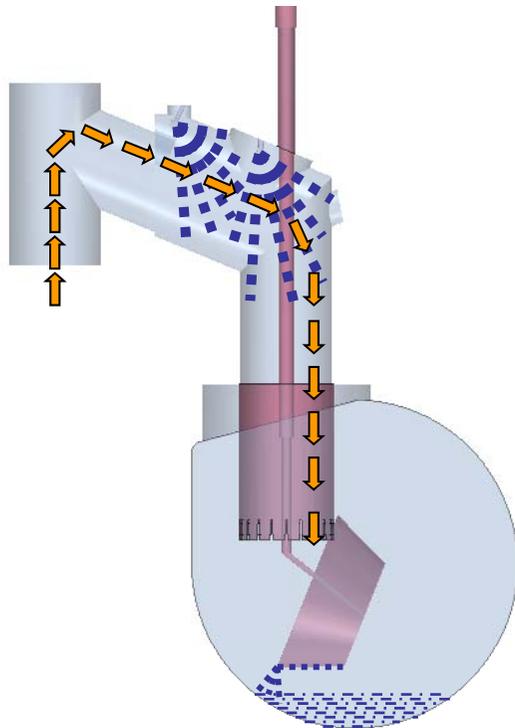


PROven[®] NG :

Operation of the rotatable cup

Oven is „**on the main**“
ready for charging

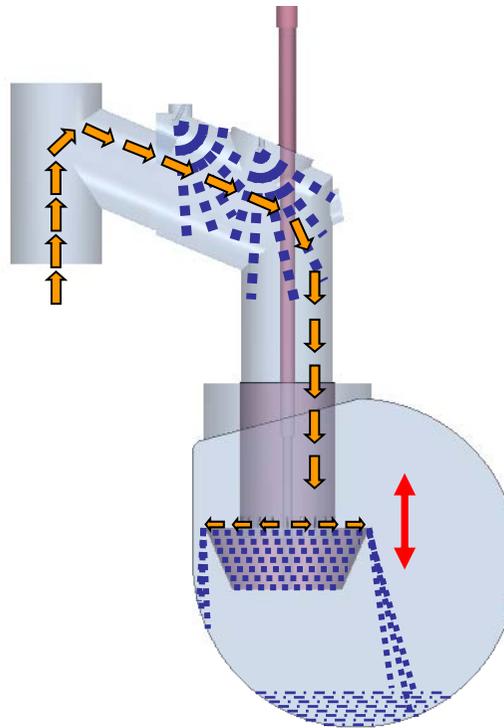
$$P_{\text{oven}} = P_{\text{collecting main}}$$



Crown pipe open;
standpipe lid is closed

Oven **pressure regulation** during
coking process

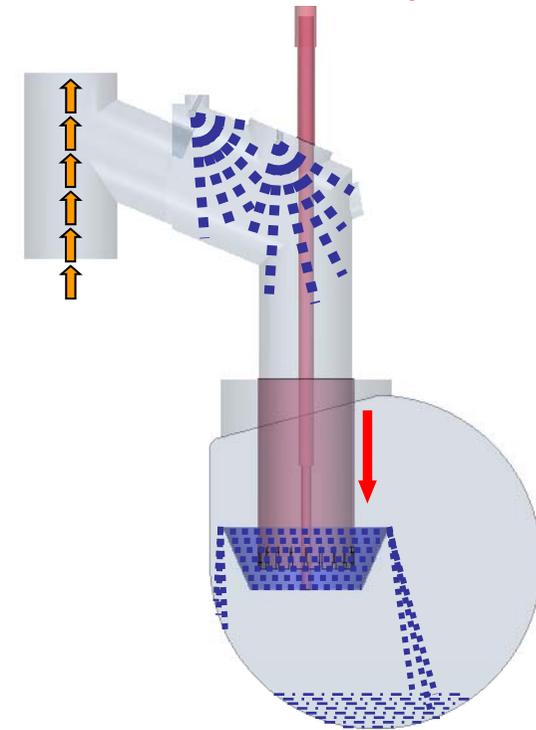
$$P_{\text{oven}} \neq P_{\text{collecting main}}$$



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



Experimental validation:

Testing of **PROven[®] NG** in a 1:1 scale model for small coke ovens in the labs of DMT

Coke Oven Pressure Control Simulation

- Variation of gas flow
- Variation of oven pressure and characteristics of pressure control
- Influence of different types of slots in the crown tube
- Behavior of water surface in the rotating valve
- Modelling of **PROven[®] NG** behaviour

Optimization of spray nozzles

- Moistening of all components

Influence of typical operation conditions

- Tilting of standpipes
- Behavior of control device

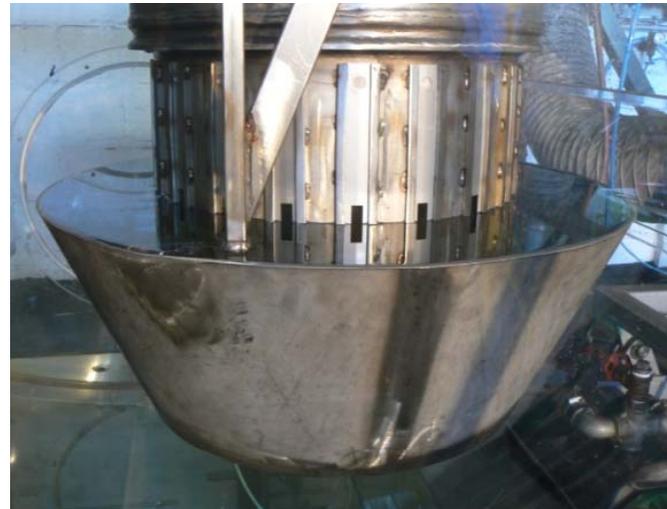




Experimental validation – Photos of **PROven[®] NG**



Oven is „**on the main**“
ready for charging



Oven **pressure regulation** during
coking process



Oven is „**off the main**“
ready for pushing

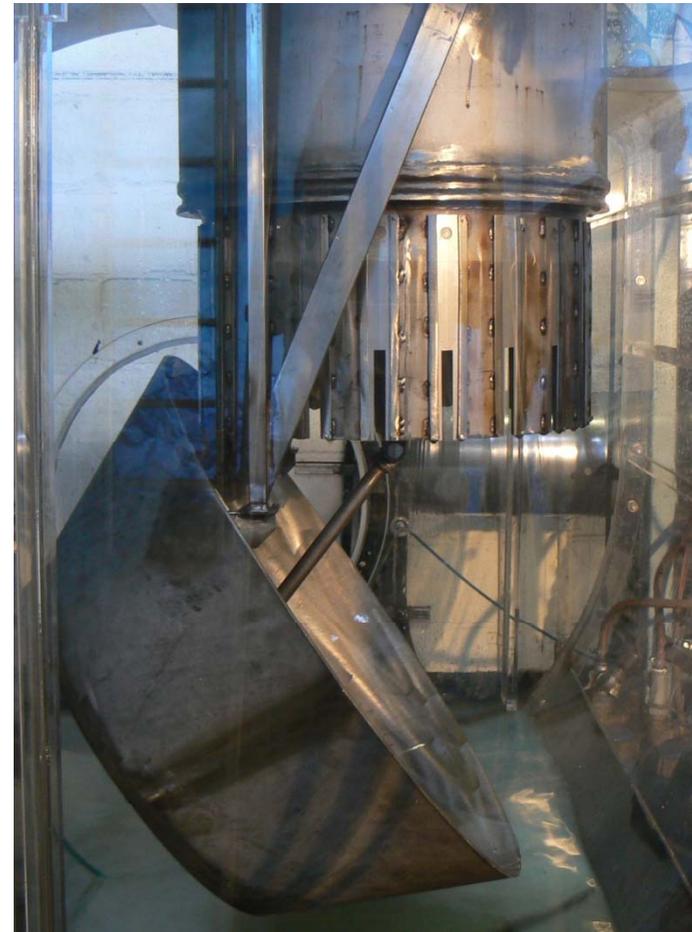
PROven[®] NG in pressure control mode





Emptying of the rotatable cup

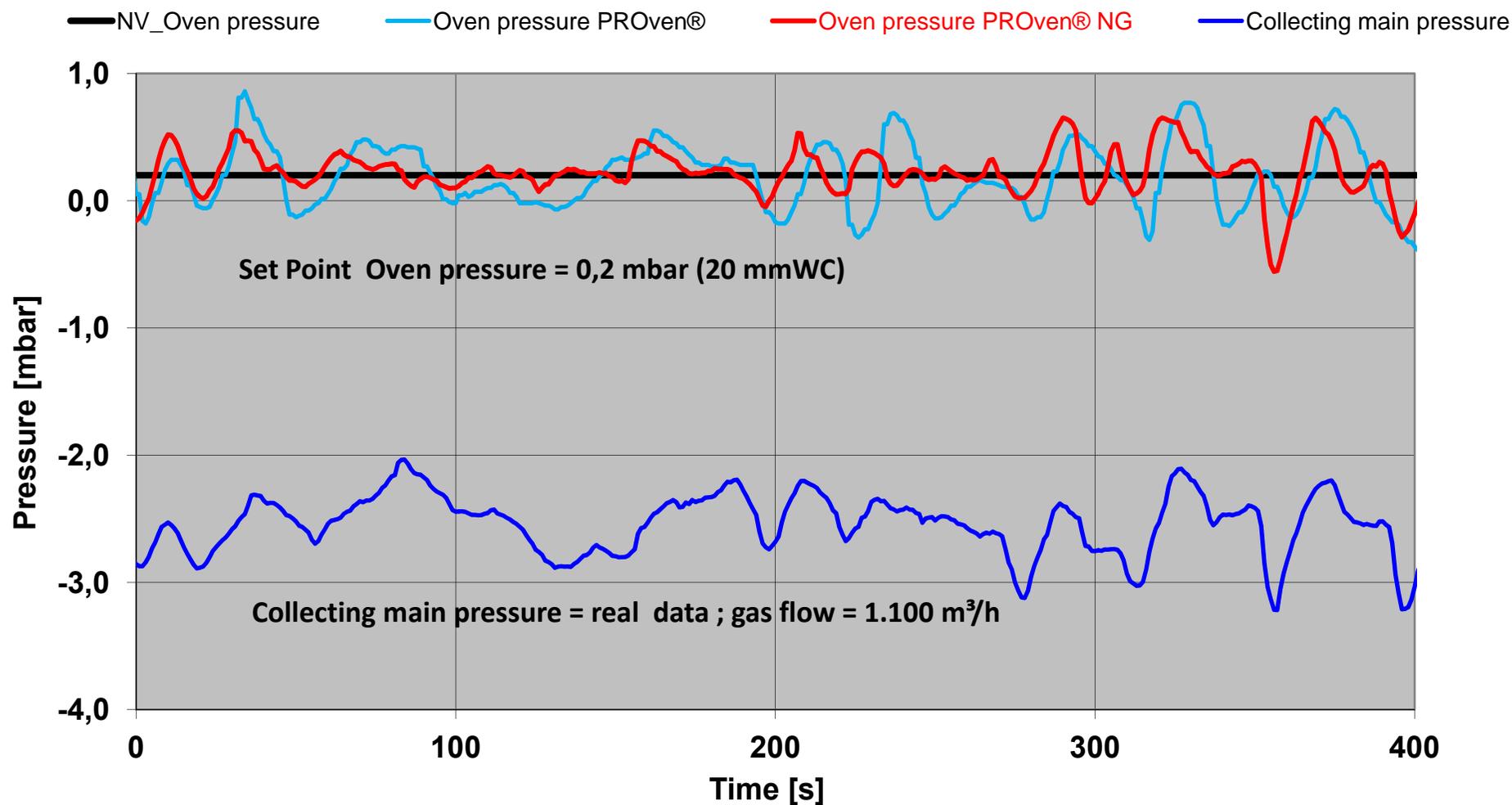
Oven is „**on the main**“ ready for charging





PROven[®] and PROven[®] NG :

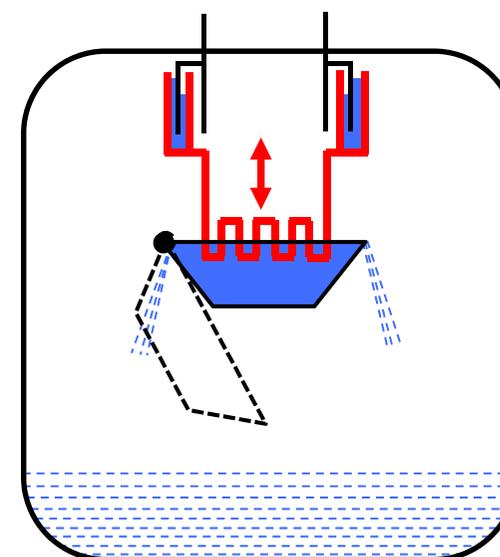
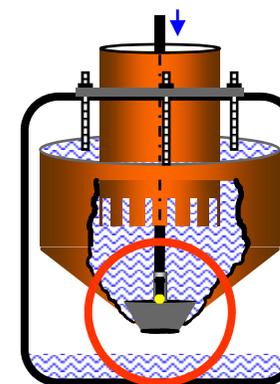
Comparison of oven pressure control





Conclusions (1/3)

- The **PROven[®] NG** design is much simpler and more rugged.
 - 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.



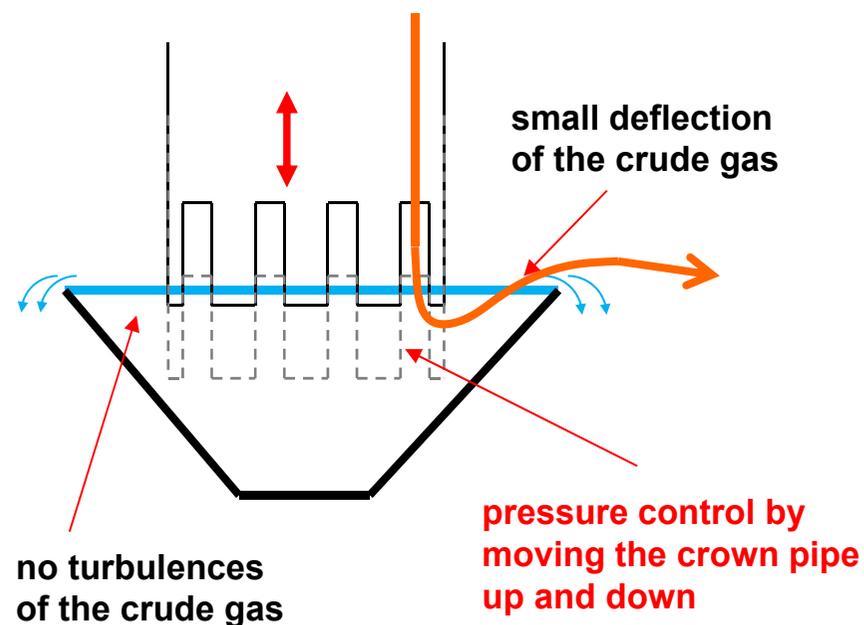


Conclusions (2/3)

- 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).

PROven[®] NG

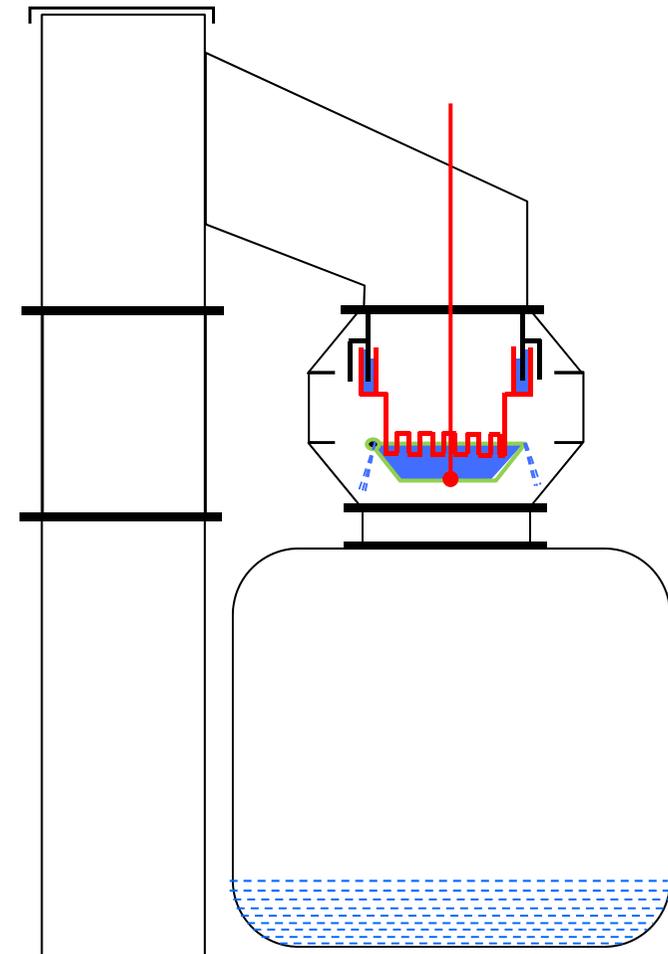
(no control drain valve necessary)





Conclusions (3/3)

- 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.





PROven[®] NG Perspectives

- The **PROven[®] NG** system has been tested in the DMT test stand as 1:1 scale model for a 4 m coke oven.
- The **PROven[®] NG** system is actually under flow modelling and simulation for scaling.
- The **PROven[®] NG** system will be tested at a coke plant in 2014.
- The **PROven[®] NG** system will be available in the market soon.



THANK YOU FOR YOUR ATTENTION!