Uhde
Expertise in coke making

“Controlling Particulate Emissions from Coke Oven Plants”

Chicago, March 24th & 25th 2010
Uhde Coke Plant Technologies
The market leader of the western world emerged from the pioneers of German coke plant technologies.

History

1872 Dr. C. Otto & Co. Coke plant engineering company
1898 Carl Still founded separate company
1901 Heinrich Koppers founded his company
1921 Foundation of engineering company Friedrich Uhde
1993 Thyssen acquires reunited coke making company Still Otto
1999 Thyssen Still Otto and Krupp Koppers became TK EnCoke
2004 ThyssenKrupp EnCoke integrated into Uhde

Dr. C. Otto
1872

C. Still
1898

H. Koppers
1901

Still Otto

Krupp Koppers

TK EnCoke

Uhde Coke Plant Technologies
- market leader in the western world
- high market share
- more than 2000 plant units

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Coke Plant – General Types

Slot-type coke oven

Heat-recovery coke oven

Positive pressure

Indirect heat transfer from sides

Negative pressure (suction)

Direct heat transfer from top

Indirect heat transfer from bottom

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### Coke Plant – Uhde Technologies per General Type

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<th>Slot type ovens</th>
<th>Non-Recovery or Heat Recovery</th>
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<td>Uhde technology provides:</td>
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<tr>
<td>- Low NO\textsubscript{x} - combustion</td>
<td>- High Capacity Ovens</td>
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<td>- High Capacity Ovens</td>
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<td>- Closed Charging under Suction</td>
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<td>- PROven System</td>
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<td>- Pushing Emission Control</td>
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<td>- CSQ Low Emission Wet Quench</td>
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Coke Plant – Particulate Emissions - Sources

Where does particulate emissions occur?

*Filling process:*
- Charging emissions

*Coking process:*
- leak emission at coke oven doors
- leak emissions at the charging lids
- leak emissions at the standpipe lids

*Pushing process:*
- Pushing emissions on the coke side of the battery

*Quenching process:*
- Wet quenching generates steam which carries particulate
What are the main influence factors on the emissions?

**Filling, Pushing & Quenching:**
- frequent of operation
- technical detail solution

  Uhde Technology
  -> high capacity ovens
  -> charging teleskop
  -> PEC system
  -> Low Emission Wet Quench

**Coking:**
- pressure in the coking chamber
- technical detail solution

  -> PROven system
  -> door sealing system
  -> lid sealing systems
  -> prevent damage of sealings
High Capacity Ovens – slot type

High capacity ovens result in a reduced number of ovens for the same capacity

- Less ovens result in:
  - less closures -> less sealing length
    - less damage risk
    - less maintenance
  - less pushes/day -> reduce frequency of handling
    -> increase lifetime expectation
  - in consequence in less emissions (fugitive and charging/pushing)
  - reduced space requirements for the plant

- Uhde build oven chambers up to 8.43 m tall (approx. 27’-8”)

- Per push up to 50 metric tons of coke (55 short tons/push)
High Capacity Ovens Built by Uhde – Asia (past years)

- **SHOUGANG Caofeidian**
  - 4 coke oven batteries
  - 7.6 m height
  - 4.0 million tpy

- **TISCO**
  - 2 coke oven batteries
  - 7.6 m height
  - 2.0 million tpy

- **WUGANG**
  - 2 coke oven batteries
  - 7.6 m height
  - 2.0 million tpy

- **MAGANG**
  - 2 coke oven batteries
  - 7.6 m height
  - 2.0 million tpy

- **YANKUANG relocation Kaiserstuhl**
  - 2 coke oven batteries
  - 7.6 m height
  - 2.0 million tpy

- **DRAGON STEEL CORPORATION Taichung**
  - 2 coke oven batteries
  - 7.3 m height
  - 1.1 million tpy

  + option
  - 2 coke oven batteries
  - 7.3 m height
  - 1.1 million tpy

- **CHINA STEEL CORPORATION Kaohsiung**
  - 4 coke oven batteries
  - 7.3 m height
  - 2.6 million tpy

- **SHAGANG**
  - 2 coke oven batteries
  - 7.6 m height
  - 2.0 million tpy

- **WUGANG**
  - 2 coke oven batteries
  - 7.6 m height
  - 2.0 million tpy

- **Taiwan**
  - 4 million tpy

- **China**
  - 14 million tpy
High Capacity Ovens Built by Uhde – Asia (past years)

**HYUNDAI STEEL CORPORATION**
- 4 coke oven batteries
- 7.6 m height
- 3.2 million tpy

**+ option**
- 2 coke oven batteries
- 7.6 m height
- 1.6 million tpy

**POSCO**
- Gwangyang
  - 4 coke oven batteries
  - 7.6 m height
  - 2.8 million tpy

- Pohang
  - 1 coke oven battery
  - 6.7 m height
  - 0.7 million tpy

**POSCO**
- Pohang
  - 4 coke oven batteries
  - 7.6 m height
  - 3.2 million tpy

- Gwangyang
  - 1 coke oven battery
  - 6.7 m height
  - 2.8 million tpy

**South Korea**
- 6.7 million tpy

**Mitsui Mining**
- Kitakyushu
  - 1 coke oven battery
  - 7.1 m height
  - 0.6 million tpy

**JFE**
- Fukuyama
  - 1 coke oven battery
  - 6.6 m height
  - 0.6 million tpy

**Kurashiki**
- 1 coke oven battery
  - 6.7 m height
  - 0.7 million tpy

**Tokyo**
- JFE
  - 1 coke oven battery
  - 6.7 m height
  - 0.5 million tpy

**POSCO**
- Pohang
  - 4 coke oven batteries
  - 7.6 m height
  - 2.8 million tpy

- Gwangyang
  - 2 coke oven batteries
  - 7.6 m height
  - 1.6 million tpy

**POSCO**
- Pohang
  - 2 coke oven batteries
  - 7.6 m height
  - 1.6 million tpy

**Japan**
- 1.7 million tpy

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Dr. U. Terhaag, Uhde Corporation of America
Reference Plant – highest capacity oven till now

ThyssenKrupp Steel Plant: Schwelgern
height: 8.43 m
2 x 70 ovens
PROven System
in operation since 2003
with By-Product Plant
Charging emissions

Charging under full suction with teleskop (no exposure)

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Pushing emissions

To PEC baghouse

PEC duct

Coke oven

Coke guide

Coke transfer car

Quench Car
Coke Stabilizing Quench & Low Emission Wet Quench

Conventional Quenching Tower

CSQ-Quenching Tower

LEWQ: Low Emission Wet Quench

CSQ: Coke Stabilizing Quench

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Coke Stabilizing Quench

Quench water (bottom filling)

Quench water spray

Quench water (bottom filling)

CSQ quenching car

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Low Emission Wet Quench

The only (!) system to reduce the dust content in quenching vapour below 15 g/t

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FlexZed Coke Oven Doors with Spring Loaded Sealing Strip

**Uhde Corporation of America**
FlexZed Coke Oven Doors with Spring Loaded Sealing Strip

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PROven - Pressure Regulated Oven

General concept:
*Reduction of the “driving force” for emissions*

Application:
*pressure control for each individual oven chamber*
(according to the varying gas amounts during the carbonization time)

- causal reduction of fugitive emissions
- operation of the gas collecting main under suction
- further developments of the PROven system
- applied in 30 coke oven batteries of Uhde since the year 2000
- approx. 1800 ovens are equipped and running
- accepted as “the best available control technology”
- permit for US Steel Corporation, Clairton Works, Battery C
Collecting Main with PROven installations

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PROven arrangement schematic

- Pressure measurement line
- \( \text{NH}_3\)-water
- Standpipe lid
- Standpipe
- Charge hole lid
- Oven roof
- Gas collecting space
- Coke oven door
- Fix Cup-valve: \( \Delta h \sim \Delta p \)
- GC-main
- Pneumatic cylinder
- Control valve
PROoven arrangement schematic

Gas Pressure in Oven Chamber and in Collecting Main

- Pressure at foot of door
- Pressure in collecting main
- Pressure in standpipe
- Suction during charging
- Collecting main under suction

Lines in red = conventional raw gas system
Lines in blue = PROoven® system

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Emission Reduction with PROven (example)

Hydrocarbons (at oven doors)

up to 73% of PAH emissions saved

<table>
<thead>
<tr>
<th>Coking Time</th>
<th>Pusher Side</th>
<th>Coke Side</th>
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<tr>
<td>0 - 2 h</td>
<td>35%</td>
<td>31%</td>
</tr>
<tr>
<td>2 - 5 h</td>
<td>27%</td>
<td>28%</td>
</tr>
</tbody>
</table>

-65% -73% -69% -72%

100%

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PROven Summary

- reduces emissions at all oven closures by keeping the pressure in the oven on a low value

- while charging oven is under full suction of GC main

- eliminates interaction between pressure of GC main and pressure in the individual oven chamber

- provides indication of raw gas quantities and carbonization conditions

- avoids the use of high pressure water or steam injection due to the operation of the GC-main under suction

- installation at existing coke oven batteries possible

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Oven design

Slot-type coke oven

Heat-recovery coke oven

Positive pressure

Indirect heat transfer from sides

Direct heat transfer from top

Indirect heat transfer from bottom

Negative pressure (suction)
## What are the main influence factors on the emissions?

### Filling, Pushing & Quenching:
- frequent of operation
- technical detail solution

**Uhde Technology**
- high capacity ovens
- compacted wet charging
- Flat Bed Pushing
- Low Emission Wet Quench

### Coking:
- pressure in the coking chamber
- technical detail solution

- always under suction
- door sealing system
- staged combustion
- prevent damage of sealings
Innovative machinery design and oven doors
Non-Recovery & Heat Recovery

- High capacity heat recovery ovens due to compacted coal charging
- Compacted charging lead to “zero charging emissions”
- Flat bed pushing ensures “near to zero” pushing emissions
- Staged combustion controls peak temperatures and reduces emissions
- Innovative tight door design leads to superior combustion control
- Permanent suction results in minimized door emissions
- High efficiency sulfur removal in a FGD plant with integrated filter
- Low Emission Wet Quench is applicable
Conclusion - Uhdes superior technology

- The conventional batteries Uhde provides the best available control technology (battery design, PROven, high capacity ovens, tight door systems, CSQ Low Emission wet Quench)

- Experience in By-Product design result in “best available environmental control” and high efficiency

- Uhde’s heat recovery technology with compacted charging, improved heat release in the oven chamber, tight door design and wet Quenching is also the “state of the art” technology

- “Zero Venting” concept offers the ability to avoid “untreated” gas release under scheduled outages of the hot gas train
Thanks you for attention!

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