Closed Coke Slurry System (CCS System)

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The Future In Delayed Coker Operations...

The Closed Coke Slurry System
To understand the future a look at available coker solids handling systems:

- **PAD/PIT Systems**
  - Most common procedure for 95% of coker units
  - Environmentally questionable
  - Poor reliability record
  - Difficult sludge handling
  - Low cost design

- **Gravity Flow Dewatering Bin Systems**
  - Only one installation
  - Expensive/ tall design
  - Difficult sludge handling via decanter/ settling tank

- **Slurry Dewatering Bin System**
  - Coke & water is pumped into a dewatering bin
  - Overflow of sludge and foam to settling tank/ skimming decanter
  - Difficult sludge handling
What can you expect from the new innovative

*Closed Coke Slurry System*...?

Fluidized operation:

* A step change in coke handling operation between cutting and load-out
  * Efficient coke dewatering
  * Environmentally sound system
  * Clever sludge & water management
How the CCS-system works:

- No overflow of sludge & foam to settling tank

- Total coke batch is used as filtration bed in the dewatering bin resulting in
  - Fast water entrainment within 6 hours
  - Effective fines retention of > 99.5 % in bed

- Consequent separation of clean water from remaining settled fines via clean water basin

- No further sludge handling required
**Typical Economical opportunities → compared to other systems**

(actual achievable return figures to be defined on a case by case basis)

- Cycle time reduction with shorter drainage time: up to 4 hrs achievable for greenfield coker
  - E.g. 1 hour gain equiv. To 10 Mio €/year on uplift effect for clean products

- Manpower savings (O&M) through consequent automatisation: 6…8 operators & technicians

- Freshwater savings with remarkable steam plume reduction: approx. 300 m³/Batch

- No losses/ outage time for PAD/PIT repair work (e.g. crane & grizzly)
  - E.g. 200 hours/ year equiv. To 5 Mio €/year on uplift effect for clean products

- Space requirement savings of up to 90% compared to PAD/PIT systems for greenfield coker
Environmental and Safety benefits…

- Benchmark for zero dust coker, zero Volatile Organic Components (VOC's) & minimum steam plume losses
- Creates safe and healthy environment for fellow workers and neighbourhood
- Improves fire and accident records for coker units instantly
- Effective fines- & water-management / mess free sludge handling
- Unmatched system reliability (99.5% +) through unique design & construction features plus material selection
Cycle Time Reduction enables more clean Products

Cycle Time Reduction with shorter drainage time up to 4 Hours achievable for Greenfield Coker.

Downstream Equipment capacity permitted.
Closed Coke Slurry System (CCS System)

Quench Cycle
CLOSED COKE SLURRY SYSTEM (CCS SYSTEM)

Drum Decoking + Coke Dewatering
CLOSED COKE SLURRY SYSTEM (CCS SYSTEM)
CLOSED COKE SLURRY SYSTEM (CCS SYSTEM)

Dewatering Cycle

Dewatering Bin A
CLOSED COKE SLURRY SYSTEM (CCS SYSTEM)
The Crusher principle....

....acts as a bucket-wheel type device, serving multiple purposes:

- Holding positively back the full coke batch – no avalanche surprises
- Unlimited pulling/ ‘swallow’ capacity from upstream coke batch
- Coping with any type of coke
- Matches any impact loads & any cutting rates in future
- Transporting and releasing uniformly crushed coke to downstream sluice
- Independent high torque direct drive each roll
- automatic chute raising and docking to drum flange or bottom valve
CLOSED COKE SLURRY SYSTEM (CCS SYSTEM)

Coke Crusher assembly

- 80 tons of special material
- unique design and construction features
- 50 mm / 2” wall casing thickness
Unique system components & features provides safe, reliable and long life cycle operation

Double Roll Crusher with integrated Chute  (Proprietary Design)

- High Torque direct drive each roll
- Crushing ratio 10:1;  e.g. 1.000 mm --> 100 mm ;  40” --> 4” resp.
- Safe & remote operation:
  - Hydraulic chute raising
  - Docking automatic to drum flange or bottom valve
**Closed Coke Slurry System (CCS System)**

- **Closed Slurry Pipe**  
  (Proprietary Design)
  - Design and construction for optimum slurry transportation
  - Special material selection for long life cycle

- **Slurry Pump**  
  (Proprietary Design)
  - Design, construction and materials for long life cycle
  - Designed to run in cavitation region
DEWATERING PRINCIPLES

- **Open Pile**
  - Free water drainage is hampered by counterflow steam out
  - Dry surface, but wet central & floor region of pile (wet foot)
  - Overall high water content remaining --> 'after-drainage' during transport
  - Manual hosing down and handling of sludge via maze

- **Closed System Dewatering**
  - Drum walls and cone section fitted with screens for uniform dewatering
  - Minimum travel time and short, uniform distances for water to screen
  - Standardized lump size of 4" /100 mm provides maximum free channels between coke for high water velocity
  - High water velocity results in maximum fines retention (sludge retention rate in Dewatering bin: 99.5 %)
Dewatering in a Coke Pile / Open Pit

Closed Coke Slurry System (CCS System)

Top Region
Water removal via vaporization (Dry tip)

Middle Region
Mixed Area of up-flow vapor & down-flow liquid

Ground Region
Water accumulation at grade (Wet feet)
**DEWATERING BINS** *(PROPRIETARY DESIGN)*

![Diagram of dewatering bins]

**Bin Dewatering Effect over Time**

- **X-axis:** Dewatering Time [Hours]
- **Y-axis:** Free Water in Coke [%]

The graph illustrates the dewatering effect over time, showing a decrease in free water in coke as dewatering time increases.
### Typical Dewatering Schedule

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum decoking / cutting</td>
<td>3</td>
</tr>
<tr>
<td>Coke crushing (In-Line)</td>
<td>3</td>
</tr>
<tr>
<td>Instant coke dewatering in the dewatering bin</td>
<td>6</td>
</tr>
<tr>
<td>Coke transport/ load-out</td>
<td></td>
</tr>
</tbody>
</table>

**Total Time for dewatering: 6 hours**
Experience facts on an existing unit with over 6 Years operation, representing latest CCS-system technology

- No dedicated field operators required
- Maintenance free; reliability factor 99.5% +
- 6 Years uninterrupted operation equivalent to 3,000 Cycles
- No deterioration in the slurry & cutting water pump performances
- No corrosion and erosion in the total CCS System
- No fire, no incidents
- Delivers commercially dry coke with 10% humidity
- only 0.5% of coke fines ends in the slurry pit and pumped to next coke batch
How Will The Closed Coke Slurry System Be Implemented?

**Retrofit** e.g. Replacement for Open PAD/ PIT

- Suitable for Multi-Drum Coker
- footprint fits into any existing coker, maximum layout flexibility, even offsites
- CCS-System footprint to suit in than idle open pit or elsewhere
- Implementation within regular coker turnaround possible
- Basin construction in concrete (UG) or steel work (AG) possible

**Greenfield installation**

- takes away authorities environmental concerns during project approval phase
- for optimum project embetting, early involvement in FEED phase suggested
- higher throughput with shorter cycle time possible with planned-in of downstream equipment capacity reserve
Summary - main advantages of the CCS-System

- Immediate and sustainable Health, Safety and Environmental benefits
- Payout time < 1.5 years for greenfield application achievable
- Proven state-of-the-art technology
- Automated operation
- Typical refining process steps, high workers acceptance level
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TYPICAL LAYOUT FOR 2 DRUM COKER
Thanks for your attention

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