IMPACT ON PRODUCTIVITY BY SMART ENGINEERING

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Current orders

Uhde

Dangjin, Corea

Phase 1/2
- 7.63m Battery
- 3 Sets of Machines
- Completion 10/2011

Phase 3:
- 7.63m Battery
- 3 Sets of Machines
- Completion 10/2013

Gwangyang, Corea

- 7.63m Battery
- 3 Sets of Machines
- Completion 12/2011

Uhde

Angul, India

- 7.6m Battery
- 2 Sets of Machines
- Completion 03/2013

Volta Redonda, Brazil

- 6m Battery
- 1 pc. OSDM – One-Spot-Door-M/C w/Coke Guide
- Completion 10/2012

CSN

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Background:

**Historic Design**

- Customers usually steel / coke producers own individual experience by internal R&D
- Equipment ordered by their own specification for required battery and machine characteristics

**Today’s design challenge**

- Reduced customer efforts for internal R&D
- Customer depends on supplier’s experience to get best-in-class battery and machinery equipment at specified performance
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Changed requirements:

- Technology
- Design

SPECIFIED EQUIPMENT

SPECIFIED PERFORMANCE

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Engineering Demands:

- Machine performance depends on battery and/or other plant process
- Process depends on interaction between machines and battery
- Prevention of process disturbances through measures at upstream plant units
- Suitable solutions require knowledge of related process cycle
Example - Graphite Formation

**Cause:**
- Inappropriate temperature profile
- Uneven coal charge
- Charging level too low

**Countermeasure:**
- Cleaning devices
- Clear cause instead of symptom

**Cause prevention:**
- Improve charging process
- Adjustment of levelling sequence
Example - Controlled Charging

- **HOOD**
- **MAX. FILLING LEVEL**
- **COAL HOPPER w/ GAUGED VOLUME**
- **LOAD CELL**
- **PLC**
- **FREQUENCY INVERTER**
- **TELESCOPE**
- **SCREW FEEDER**
- **LOAD CELL**
- **SPEED-CONTROLLED DRIVE FOR SCREW FEEDER**
- **CHARGING HOLE**
- **“COAL PLUG” REMAINING COAL AFTER CHARGING**

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Example - Charging Characteristics

- Coal charge before levelling to achieve optimal charging grade
- Coal tip $H_{Fi}$ should be measured for adjustment of charging volume
- Compensation of increased density by compacting in oven chamber

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Optimizing of coal charge

Gauge bar
- Manual Measurement
- Bad reproducibility
- Hazardous

Mobile measuring device
- Easy to handle
- Fast operation
- Contact-free
- Reproducible data
- Recordable data
- Fits below telescope
- Safe

yesterday
today
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Optimizing of coal charge:

- Compensation of coal densification
- Adjustment of coal charge on levelling
- Self-regulating charging process
- Feeder screw offset to charging hole
- New design required of screw feeder and discharge housing
- Ideal on overhauling of equipment
Charging Optimization (6 m battery in 2011/2012)
- Assessment study
- Re-definition of charging sequence
- Implementation of revised charging software
- Commissioning of charging process
- Performance test
- On-site training

Results:
- Re-adjustment of design capacity of coal charge
- Exceeding of design capacity by considering coal densification
- **Increase of coke production by 4%**
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Advantage of solution

- Integral process examination
- Easy detection of root cause
- Elimination of failure sources
- Retrofitable on equipment overhauling

- Target-oriented problem solving
- Applicable for individual tasks by SCHALKE Service
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Service conception:

PURPOSE:

INCREASE OF PRODUCTIVITY

SERVICE 1. STEP:

QUICK-CHECK - PROCESS ANALYSIS

POTENTIAL:

CYCLE TIME REDUCTION
CHARGING OPTIMIZATION
MINIMIZING DOWNTIME
PERSONNEL DEVELOPMENT
INCREASED PERFORMANCE
EMISSION REDUCTION

SERVICE OPTION:

MAXIMIZING SPEED OF ACTUATORS
SOFTWARE REVIEW
M/C COORDINATION REVIEW
STRENGTHEN SKILLS BY REGULAR TRAINING
INCREASE AUTOMATION LEVEL
COMMON ACTIVITIES WITH PLANT SUPPLIER

SOFTWARE REVIEW
ADJUSTING CHARGING VOLUMES
ADJUSTING SENSOR SYSTEM
MAINTAINING OF EXPERTISE
MINIMIZED GRAPHITE
REDUCED LOSS OF PRODUCTION
LESS REPAIR

M/C COORDINATION REVIEW
ADVANCED SENSOR TYPES
REPAIR TRAINING
UPGRADE TO SHIFT-MODE OR MANLESS OPERATION
UPGRADES FOR PROCESS IMPROVEMENT

AGREEMENT FOR ACTIVITIES AND SCOPE OF SUPPLY:

IMPROVED ACTUATORS
DETECTION SYSTEM FOR CHARGING LEVEL
COOR UPDATE
OPERATOR TRAINING
UPGRADE TO SHIFT-MODE OR MANLESS OPERATION

CONTROL UPDATE
PROCESS UPDATE
ADVANCED SENSOR TYPES
REPAIR TRAINING
PROCESS UPDATE

VALUE:

HIGHER PRODUCTION BY INCREASED NO OF OVENS
HIGHER PRODUCTION BY INCREASED THROUGHPUT
MINIMIZED GRAPHITE
HIGHER AVAILABILITY
REDUCED LOSS OF PRODUCTION
HIGHER AVAILABILITY
REDUCED REPAIR TIME
MORE PRODUCTION
HIGHER AVAILABILITY
LESS DOWNTIME
LESS REPAIR

HIGHER AVAILABILITY
MORE PRODUCTION
HIGHER COKE QUALITY

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**Service approach:**

**PURPOSE:**

1. **SERVICE 1. STEP:**
   - CHARGING OPTIMIZATION
   - CYCLE TIME REDUCTION
   - MINIMIZING DOWNTIME
   - PERSONNEL DEVELOPMENT
   - INCREASED PERFORMANCE
   - EMISSION REDUCTION

2. **POTENTIAL:**

   a. SOFTWARE REVIEW
      - ADJUSTING CHARGING VOLUMES

3. **SERVICE OPTION:**

   b. QUICK-CHECK - PROCESS ANALYSIS

4. **AGREEMENT FOR ACTIVITIES AND SCOPE OF SUPPLY:**

   c. DETECTION SYSTEM FOR CHARGING LEVEL
      - PROCESS UPDATE

   d. HIGHER PRODUCTION BY
      - THROUGHPUT
      - MINIMIZED GRAPHITE

5. **VALUE:**

   e. BENEFIT

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**7.6 m Oven**

<table>
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<th>Design Data</th>
<th>Actual charging grade</th>
<th>Increase of charging grade to...</th>
<th>Yield in production</th>
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<table>
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<tr>
<th>No. of ovens per day</th>
<th>Coke per Push [tons]</th>
<th>Coke per day [tons]</th>
<th>Qty. of gas per day [Nm³]</th>
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</table>

Savings by less substitution of coke at market price...

- Coke - Import price per ton, N-Europe (VDKF Feb. 2012) 335,00 USD...per day 18.900,00 USD...
- Gas - Domestic market price per m³ (ThyssenKrupp China) 0,08 USD...per month 567.000,00 USD...
- ...per year 6.730.000,00 USD

Typical calculation

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Summary

- Many process disturbances are not caused where they occur.
- Knowledge of the whole process chain allows to develop preventions where they are most suitable.
- Solutions developed under these considerations might be simple and reliable.
- Solutions are easily retrofittable on existing equipment.
- Efforts for retrofitable solutions mostly make just a fraction of the actual benefits.

Prevent root cause instead of symptom treatment!
Thank you very much for your kind attention!