Smart Crane Features
for Intelligent Bulk Handling

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SMART CRANE FEATURES
FOR INTELLIGENT BULK HANDLING
... NOT ONLY IN THE AUTOMOTIVE INDUSTRY
OVERVIEW – LOADING AND UNLOADING EQUIPMENT

Continuous

- Small continuous loader
- Large continuous unloader

Discontinuous

- Gantry crane
- Slewing crane – single jib
- Slewing crane – double jib
- Excavator & balancer crane
KONECRANES GOTTWALD
MOBILE HARBOR CRANE (MHC)

• Stevedoring crane that is
  – self-contained
  – self-propelled
  – rubber-tired
  – multi-purpose
  – single-jib
  – slewing and luffing

• 4-rope grab version for professional bulk handling
CRANE TYPES BASED ON MHC TECHNOLOGY

Mobile harbor crane  |  Floating crane  |  Portal harbor crane
CRANE OPERATOR DEMANDS

- Cut COST
- Reduce EMISSIONS
- Increase PRODUCTIVITY
- Increase SAFETY
- Lower ENERGY CONSUMPTION
- Comply with LEGISLATION
SPECIFIC BULK HANDLING CHALLENGES

- Dirty, rough surroundings
- Formation of dust
- Risk of spillage, (cross) contamination and material degradation
- Non-uniform properties of bulk material
- Extreme dynamic load impacts on handling equipment
CORRESPOND TO DEMANDS – MEET CHALLENGES

Smart crane features for Konecranes Gottwald Mobile Harbor Cranes

- Driver assistants
- Process integration
- Systems connectivity

- Efficiency
  performance, wear, availability
- Safety
  personnel, crane, load, terminal infrastructure
- Ergonomics
  driver comfort and ease
- Environmental impact
  energy consumption, emissions
INTEGRATION INTO HUMAN MACHINE INTERFACE
# KONECRANES GOTTWALD MHC – SMART CRANE FEATURES OVERVIEW

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## CARGO

- **CONTAINER**
- **BULK**
- **GENERAL/PROJECT**
GRAB
AUTO-ADAPTIVE GRAB FILL LEVEL CONTROL

• Self-learning solution – adjustment of rope pulling force

• Optimization of grab fill level, as related to
  – load capacity curve
  – grab and bulk cargo type
  – working position

• Benefits
  – Increased bulk handling rates
  – Reduced overload cut-outs
  – Extended crane lifetime
HOLD TOTALIZING

• Registers number of lifts and quantity of bulk unloaded
  – per hold and in total

• Monitoring of unloading routine given by shipping company

• Continuously updated overview of unloading process
  – for long unloading times
  – if there is a change of driver

• Improved unloading process
INTEGRATED VERIFIABLE WEIGHING SYSTEM

• Verifiable system – not just load measuring
• Dynamic weighing of bulk in the grab – independent of crane operator
• Fast and highly precise – takes place during crane operation
• Mounted on boom tip of the crane – no additional work steps or equipment required
LOAD GUIDANCE & MOTION AUTOMATION
LOAD GUIDANCE SYSTEM

• Several features, including
  – load anti-sway
  – hoisting height setting/limitation
  – work area limitation
  – (semi-)automatic point-to-point handling

• Automation of frequently repeated crane motions

Benefits:
  – Simplified operation of the cranes
  – Increased safety
  – Higher handling rates even for inexperienced crane driver
HOISTING HEIGHT SETTING/LIMITATION

• Upper and lower hoisting height limits defined by crane operator

• Hoisting motion is stopped automatically at upper and lower hoisting height limit
WORK AREA LIMITATION

• Prevents
  – collision with adjacent buildings and terminal equipment
  – straying into the working area of other cranes

• Drives are automatically slowed down in advance

• Drive speeds determine the point at which deceleration begins
SEMI-AUTOMATIC POINT-TO-POINT MOTION

• Repeated movements between the defined two positions are semi-automated

• Assists the crane operator with repeated movements between same positions, e.g.
  – the vessel's hold and
  – the hopper or the stockpile
ADVANCED SEMI-AUTOMATION

• In addition to semi-automated luffing and slewing motion, semi-automated hoisting motion

• Semi-automatic control path
  – Definition of working zone (e.g. ship hatch, safe working height)
  – Automatic calculation of safe zone
  – Automatic calculation of optimized control path
SEMI-AUTOMATIC CONTROL PATH

Semi-automatic motion along path
P0 - P1 - P2 - P3 - P4 - P1 - P0

Hopper safety zone

Hatch working zone

P0
P1
P2
P3
P4
# Levels of Automation – Stages of Autonomy

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<tr>
<td>No assistance</td>
<td>Assisted</td>
<td>Partially automated</td>
<td>Highly automated</td>
<td>Fully automated</td>
<td>Autonomous</td>
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<tr>
<th>Human</th>
<th>Transfer of responsibility</th>
<th>Machine</th>
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CONCLUSION

- Smart crane features are a response to industries megatrends, operator demands and bulk specific challenges
- They considerably improve crane efficiency, safety, lifetime and environmental impact
- Konecranes is committed to these trends and to automation
- Our mobile harbor cranes already dispose of numerous smart features
- Semi-automatic operation is a standard today
- We are working on the future of fully automated bulk crane operation
NOT JUST LIFTING THINGS, BUT ENTIRE BUSINESSES