IAEA Workshop
Remote Handling / INAS

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Part 1- Remote Handling
Part 1 - Remote Handling

- Conceptual explanation
- Historical development
- Remote handling technology
Conceptual Explanation

- The remote handling allows it to operate by remote control a machine which is in a danger area.

- The system consists of an operator and a manipulator. The operator gives instructions and the manipulator executes them. So that the operator can stay at a safe place, an information and/or energy transfer must exist between him and the manipulator.

- The information and energy transfer happens about cable, wirelessly only information can be transferred.

- A remote-handled manipulator mostly has multiple video cameras therewith the operator can also navigate and work on non-accessible places.
Historical Development

Ctesibius of Alexandria
approx. 250 BC

1495
Leonardo da Vinci

1897
Nikola Tesla
Historical Development

- 1945 - Development of master-slave manipulators (remote handling)
- 1954 - "Programmed transportation of goods" (industrial robots)
- 1959 - First commercial robots from Planet Corporation (controlled via Cam discs and limit switches)
- 1961 - Using freely programmable robots
- 1968 - First mobile robots with image recognition of the surrounding area and touch sensors
- 1969 - The first industrial robots in Japan
- 1970 - The first industrial robots in Europe
- 1975 - SCARA robots in Japan (six-axis articulated arm)
- 2010 - Humanoid Robot
- Next - Artificial intelligence & multi-function implement
Historical Development

- The first master-slave-manipulator was developed in 1949 to move around components in the research reactor in Argonne Nationwide Laboratory (USA)
Remote Handling Technology

Remote handling device

- Diameter rod: 14 or 20 mm
- Handle of anodized aluminum
- Rod and tongs of stainless steel
- Dimensions / weight: L = 1000 mm / weight approx. 1 kg

Source: Wälischmiller Engineering GmbH, Universally grab arm A01
Remote Handling Technology

- Master-slave-manipulators
  - Main application
    - Versatile, particularly for people in hazardous environments where heavy work is run
  
  - Advantage
    - Functions of the human arm modeled
    - Universal/multi-use
    - Extensive equipment

- Disadvantage
  - Permanently installed in the wall
  - Limited working range
  - Limited power and strength

Source: Wälischmiller Engineering GmbH, Master-Slave-Manipulator system HWM A100
Remote Handling Technology

- Master-slave-joint-manipulators
  - Advantage
    - Functions of the human arm modeled
    - Universal/multi-use
    - Rotational and pivoting motion of the gripper are transmitted in a 1:1 ratio
    - Extensive equipment
  - Disadvantage
    - Permanently installed in the wall
    - Limited working range
    - Limited power and strength

Source: Wälischmiller Engineering GmbH, Master-Slave-Manipulator system HWM A200/A201-E
Remote Handling Technology

- Master-slave-manipulators in use

Source: WAK Karlsruhe GmbH
Remote Handling Technology

- Power manipulators
  - Advantage
    - High load capacity
    - Versatile use with optional crane hook
    - Extensive equipment
  - Disadvantage
    - Relatively slow
    - No mechanical adjustment possibility

Source: WAK Karlsruhe GmbH, Manipulator TA 40
Remote Handling Technology

- Power manipulators in use

Bracing device
Manipulator arm
Extendable cross-arm for barrels
Collision metal sheet
Positioning of the barrel

Source: WAK Karlsruhe GmbH, Hersteller Siempelkamp
Remote Handling Technology

- Driverless transport systems
  - Main application
    - Highly contaminated/ activated areas
    - Accident investigation
  - Advantage
    - Most remote radio-controlled
    - Relatively mobile
    - Versatile used
  - Disadvantage
    - Limited load
    - Soil bound
    - Energy supply, restricted workspace

Source: Kerntechnische Hilfsdienst GmbH
Remote Handling Technology

- Driverless transport systems

Source: Kerntechnische Hilfsdienst GmbH
Remote Handling Technology

- Driverless transport systems

either radio or cable control possible

Source: Kerntechnische Hilfsdienst GmbH
Remote Handling Technology

- Driverless transport systems

Source: Kerntechnische Hilfsdienst GmbH

SMF
Remote Handling Technology

- Driverless transport systems

Source: Kerntechnische Hilfsdienst GmbH
Remote Handling Technology

- Driverless transport systems in use

Source: WAK Karlsruhe GmbH
Part 2 - Innovative Demolition Of Massive Reinforced Concrete Components - INAS
Content

- Part 2 - Innovative Demolition Of Massive Reinforced Concrete Components - INAS
  - General project data
  - Procedure chain
  - Cutting technology
  - Outlook
General Project Data

■ Aim of project:
Description of the comprehensive procedure chain of the demolition of reinforced concrete up to the appropriate packaging for final disposal site in contaminated or activated areas

■ Sponsored by the

Federal Ministry of Education and Research

■ Cooperation between university and industrial enterprise
Procedure Chain

Absorption → Size, Weight (Yes/No) → Pneumatic Conveying → Structure (Yes/No) → Packaging

- Absorption
- Size, Weight: Yes/No
- Separation C/R
- Reinforcement
- Concrete
- Size: Yes/No
- Crusher
- Size: Yes/No
- Shredder
- Size: Yes/No
- Mixer
- Storage
- Distributor
Cutting Technology

- Application of mechanical processes
  - Separation of the functions and test of both processes independent of each other for the demolition of concrete and reinforcing steel
  - Combine both methods in one tool

- Concrete
  - Adaptation of the undercutting technology for high-strength rocks
  - Additional suggestion with impulse forces (ODC)

- Reinforcement steel
  - Demolition by means of defined cutting edge (mill cutting)
Cutting Technology

- Combination of undercutting and mill cutting

Undercutting of concrete (ODC)  
Mill cutting of reinforcement

Source: Herrenknecht AG
Cutting Technology

- Oscillating disc cutter ODC

Source: Herrenknecht AG
Cutting Technology

Oscillating disc cutter ODC – test results

- s = 40 mm/s
- d = 10 mm
- f = 50 Hz

- s = 90 mm/s
- d = 10 mm
- f= 50Hz

Source: Herrenknecht AG
Cutting Technology

- Mill cutting of reinforcement
  - Cutters with exchangeable inserts
  - Variety of exchangeable inserts
    - Design
    - Substrate of the base metal
    - Coating, layers
      - CVD - Chemical Vapor Deposition
      - PVD - Physical Vapor Deposition
      - CBN - Cubic Boron Nitride
      - PKD - Polycrystalline Diamond

Source: Herrenknecht AG, NGK
Cutting Technology

- Mill cutting of reinforcement – test results

Source: Herrenknecht AG,
Outlook

- Carry out further tests of concrete and reinforcement cutting
- Choice of the suitable tool geometry and cutting materials
- Combination of both cutting technologies
- Investigation of the process parameters and the reaction forces
- Optimization concerning the level of demolition
Thank You
For Your Attention!