Technology and Management for the Decommissioning of Nuclear Facilities

IAEA Workshop “Decommissioning Technologies”
6 - 10 July 2009 in Karlsruhe, Germany

Prof. Dr.-Ing. Sascha Gentes
Universität Karlsruhe (TH)
Institute for Technology and Management in Construction (TMB)
gentes@tmb.uka.de

Agenda

1. Karlsruhe Institute of Technology (KIT)

2.1 Institute for Technology and Management in Construction (TMB)

2.2 Shared Professorship for Technology and Management for the Decommissioning of Nuclear Facilities

3. Shaving Technology

4. Cutting Technology

5. Summary
1. Karlsruhe Institute of Technology (KIT)

Universität Karlsruhe (TH)  
- 11 Faculties  
- 120 Institutes  
- 4,000 Employees  
- 18,500 Students  
- 299 m € Budget  

Institute of Technology (KIT)  
- Southern Campus  
- Northern Campus  
- Technology and Management for the Decommissioning of Nuclear Facilities  
- IAEA Workshop "Decommissioning Technologies" - 10th of July 2009  
- Prof. Dr.-Ing. Sascha Gentes

Lecture  Research  Innovation

2.1 Institute for Technology and Management in Construction (TMB)

The TMB represents the major field of „Construction Management“ within the Department of Civil Engineering-, Geo- and Environmental Sciences at the Universität Karlsruhe (TH).

Facts and Figures
- approx. 20 students per year
- 35 employees, thereof
  - 3 professors
  - 22 research assistants
  - 4 employees at the workshop

Universität Karlsruhe (TH)
- Forschungszentrum Karlsruhe
- 10 Programmes
- 21 Institutes
- 3,700 Employees
- 300 Acad.Ass./Stud.
- 408 m € Budget

Karlsruhe Institute of Technology (KIT)
- 10 Programmes
- 21 Institutes
- 3,700 Employees
- 300 Acad.Ass./Stud.
- 408 m € Budget

Universität Karlsruhe (TH) Forschungszentrum Karlsruhe  
- gegründet 1825

2.1 Technology and Management in Construction (TMB)
Workshop and Testing Facility

Location of the Testing Field close to FZK
Resources

- Construction machinery
- Aggregates for concrete crushing
- Underwater testing facility
- Mock-ups on a scale of 1:1

International Co-operations of TMB

- Purdue University, USA
  Construction Engineering and Management

- University of Tokyo, Japan
  Department of Civil Engineering

- Uni Federal do Parana, Brasil
  Sector Technologia, Centro Politecnico

- Universidade Federal da Bahia, Brasil
  Escola Politécnica

- Technical University of Cluj, Romania
  Faculty of Civil Engineering

- Indian Institute of Technology Madras, India
  Building Technology & Construction Management
Our Main Targets in Research and Consulting

The main targets in research and consulting of the Institute for Technology and Management in Construction are:

- Construction Process Engineering and Site Management
- Construction Equipment
- Construction Management
- Facility Management
- Lean Management
- Hazard Management

Since 1992 research is being conducted in the area of „Decommissioning and Deconstructing Reinforced Concrete Structures at Nuclear Power Plants“.  

Sample Projects:

Demolition of a heavy concrete slab (ρ = 4,200 kg/m³) with a thickness of approx. 2 m at the Compact Sodium-cooled Nuclear Reactor (KNK) at Forschungszentrum Karlsruhe.

1. Conveyance tube
2. Excavator for decommission works
3. Separator for coarse materials
4. Micro filter
5. Suction unit with sound absorber
Sample Projects:

Mock-up and test run at the testing facility of TMB

Sample Projects:

Operation of the tested equipment at the KNK
Sample Projects:

Filtration system and its separation efficiency

Separator for coarse materials from 150 mm to 0,2 mm

Sample Projects:

Waterless diamond wire saw technology
Sample Projects:

Tests for the milling of reinforced concrete walls inside of a sluice

2.2 The Shared Professorship of Technology and Mgmt. for the Decommissioning of Nuclear Facilities

New Professorship at the Karlsruhe Institute of Technology since 2008

- Announced within the scope of the future concept „KIT“
- Alternating activities at the KIT and the main sponsor’s company
- Sat. Kerntechnik GmbH (main sponsor)
- Other partners
Fields of Activity within the Shared Professorship

- Setup of a scientific and technical team of excellence for the decommissioning of nuclear facilities at KIT
- Development of new practical decommissioning technologies
- Setup of a graduate course for „Operation, Demobilisation and Decommissioning of Nuclear Facilities“

3. Shaving Technology

Autonomous MANipulator for Decontamination Assignments (AMANDA)

- Equipped with a milling attachment for decontamination purposes
- Can be operated on walls and ceilings
- Vacuum technology provides the connection between the manipulator and the object to be treated
- Requires 1 operator
Basic Tests: Surface Abrasion and Tools

- Milling disc (n) \[\rightarrow\] Roughness
- Feed (v) \[\rightarrow\] Precision
- Downforce (F) \[\rightarrow\] Manipulator
- Milling power (P) \[\rightarrow\] Operating efficiency

Parameters of the 20 Testing Series

<table>
<thead>
<tr>
<th>Milling depth</th>
<th>Feeding speed</th>
<th>Milling discs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mm</td>
<td>1 m / min</td>
<td>disc 1</td>
</tr>
<tr>
<td>3 mm</td>
<td>2 m / min</td>
<td>disc 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>disc 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>disc 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>disc 5</td>
</tr>
</tbody>
</table>
Surface Textures (Roughness of the Surface $R_a$)

Disc 1  
Disc 2  
Disc 3

Vacuum Suction Plates Experiments

Determination of the maximum suction power of suction plates with diameters of 160 mm and 200 mm

$F_{H,\text{max}}$ and $F_{V,\text{max}} = f (\text{disc}, \text{milling depth}, \text{roughness } R_a)$
Interdependence of the maximum Suction Force and the Roughness of the Surface $R_a$

**AMANDA Simulation Studies**
Easy and Flexible Assembly

0 kg

Easy und Flexible Assembly

96 kg
Easy and Flexible Assembly

159 kg
Technical Details

- Energy supply: compressed air (max. 6 bar, 1,200 l/min), electricity
- Performance: 4 m²/h (at a milling depth of approx. 3 to 4 mm)
- Personnel: 1 operator
- Wastage: suction plates (robust, easy to change) milling discs (minimized waste)

Improvement of other Attachments

Concrete of Mock-Up:
- reinforcement 200 kg/m³
- quality of concrete C30/37
Greater Objective of the Basic System AMANDA

Autonomous recording of the surface contamination through a combined system of the manipulator and a measurement device

Subsequently, autonomous milling of the surface, specific to the needs, through a combined system of the manipulator and a laser.

Customized Adjustments and Improvements

- Two operators
  - For fix ceiling heights
  - With rollers
- Two mills with extraction
  - For room heights up to 4 m
  - Autom. milling process
- One operator
  - Independent from heights
  - With trolley
Outlook

Automated Wire Saw Technology for Underwater Disassembly (ASTU)

- Three-year research project, financed by the Federal Ministry of Education and Research (BMBF), reference key # 02S8608
- Recording and modelling of all cutting parameters for any geometries available
- Practical related research in co-operation and with the support of Siempelkamp Nukleartechnik GmbH and Hilti Corporation / Liechtenstein

5. Summary

Current Co-operation partners:
sat. Kerntechnik GmbH
Wiederaufarbeitungsanlage Karlsruhe (WAK)
EnBW Kernkraft GmbH
Herrenknecht AG
Siempelkamp Nukleartechnik GmbH
Hilti Corporation
TU Dresden

Future Co-operation partners:
… IAEA ?
Thank you for your attention.

Contact:
Universität Karlsruhe (TH)
Prof. Dr.-Ing. Sascha Gentes
Email: gentes@tmb.uka.de
Homepage: http://tmrk.tmb.uka.de