

# Research Institute of Post-Mining, TH Georg Agricola University, Bochum, Germany – Strategies, Activities and Research Priorities

In the Federal Republic of Germany the hard coal production will be phased out by the end of 2018. The abandonment of the coal mining industry triggers a crucial structural change in the former mining regions which has to be planned and shaped actively. In order to come up with the challenges, risks and chances of post-mining, the TH Georg Agricola University, Bochum, Germany, established a new master program for post-mining which is unique in the world. In addition, the Research Institute of Post-Mining is founded. It investigates possible solutions for central issues in coping with the perpetual obligations. A major task of the Research Institute is to maintain and pass on the mining-based know-how. The establishment of the Master course and the Research Institute is specifically promoted by the RAG-Foundation, Essen, Germany. This includes the foundation of an endowed chair.

## 1 Introduction

Subsidised coal mining comes to an end in Germany in 2018. The coal industry is set to leave behind a wide range of tasks that will have to be fulfilled. Particular focus here will be on the “perpetual tasks” and from the year 2018 onwards the financing of these operations in the Ruhr, Saar and Ibbenbüren coalfields will be the responsibility of the Essen-based RAG Foundation. The TH Georg Agricola, formerly the Bochum School of Mines, will have a special role to play in this area. After turning out new mining engineers for the industry for more than 200 years it is now time to equip the latest batch of graduates for the specialist tasks that will be part of the post-mining age. With this in mind the master’s course “Geotechnical engineering and post-mining” was accredited back in 2012

and became a regular part of the university curriculum in the summer semester of 2013. The university is currently engaged in building a “Research Institute of Post-Mining”. The master’s course “Geotechnical engineering and post-mining”, along with the coal-industry perpetual tasks and the new Research Institute, are all presented and discussed below.

## **2 Master’s course “Geotechnical engineering and post-mining”**

The master’s course “Geotechnical engineering and post-mining”, which is the only one of its kind in Germany, prepares engineers to take up responsible positions for planning and implementing the complex procedures required for mine closure and aftercare. The studies combine the scientific and technical qualifications and skills needed at the interface between mining engineering, mine surveying, land surveying and geotechnics.

The master’s course “Geotechnical engineering and post-mining” is designed as a part-time programme for working students. The course, which lasts for six semesters, is consecutively structured around the University’s bachelor degree courses “Geotechnical engineering and applied geology”, “Mineral resource engineering” and “Surveying” (Fig. 1). Applicants with comparable specialisations can also be accepted. The study course ends with graduation as a Master of Engineering (M.Eng.). This gives graduates the basic qualifications to proceed to Ph.D. studies.

The master’s course comprises the following modules:

- Modules 1–4: Harmonisation themes  
(surveying, resources/mining, geotechnics)
- Module 5: Rock mechanics and mineral geology
- Module 6: Mining technology
- Module 7: Geotechnical support
- Module 8: Law
- Module 9: Hydrogeology
- Module 10: Surface stresses
- Module 11: Technical business management
- Modules 12–13: Applications
- Module 14: Master thesis and colloquium

There is already a significant demand for specialists in this area and this requirement is likely to grow in the years ahead. The University’s graduates therefore have excellent prospects of careers in a number of areas, including public bodies (mining authorities, building authorities, environmental agencies), mining companies and their follow-up operations, earthworks contractors, foundation engineering and specialist civil engineering firms, specialised engineering consultants and drilling and tunnelling contractors. The broad-based and practically oriented field of work is not restricted to post-mining activities alone, for the course also teaches skills that qualify graduates to work on projects in the Eurocode 7 category “geotech-

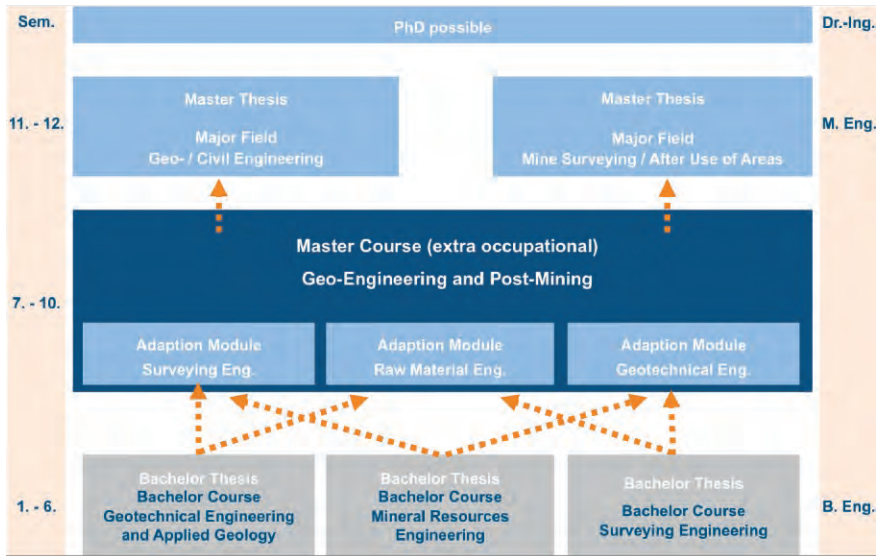


Figure 1 / Master's course "Geotechnical engineering and post-mining".

nical design". The master's course is funded by the RAG Foundation, which also sponsors an endowed professorship.

### 3 Long-term liabilities of the German coal industry

The industry's long-term liabilities – also referred-to as "perpetual tasks" – comprise all the tasks and operations that will have to be undertaken on a long-term (i.e. permanent) basis in order to ensure that the former mining regions are properly looked-after and remain agreeable places in which to live. These tasks include:

- mine dewatering,
- polder protection measures and
- groundwater remediation.

Long-term pumping operations in abandoned mine workings are required in order to protect against the infiltration of mine water into the drinking-water horizons. The RAG team in Herne is currently drawing up long-term mine dewatering plans for the various coalfield areas.

Mining-induced surface subsidence on a large scale has meant that entire areas are now below the water level of the Rhine, Ruhr, Lippe and Ems rivers. Surface pumping operations will therefore have to be maintained on a permanent basis in order to regulate the natural water balance in the polder zones. The groundwater will also have to be puri-

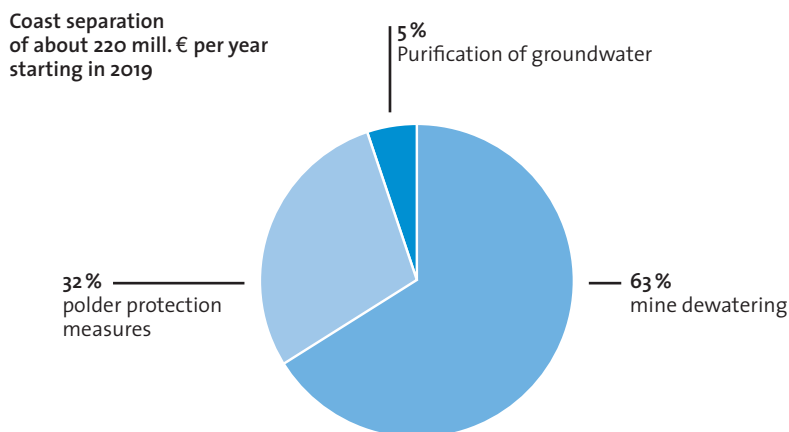


Figure 2 / Long-term liabilities of the German coal industry (RAG-Stiftung 2014).

fied in and around the sites of former coke-works.

From 2019 on the total cost of the “perpetual tasks” will be in the region of 220 mill. € a year (Fig. 2). The financing of these operations will be one of the responsibilities of the RAG Foundation.

The permanent upkeep of former mine workings and the elimination of mining subsid-  
ence are finite assignments and so do not come under “long-term liabilities”. RAG will be  
setting aside provisions for these operations in its balance sheet.

#### 4 Research Institute of the Post-mining Era

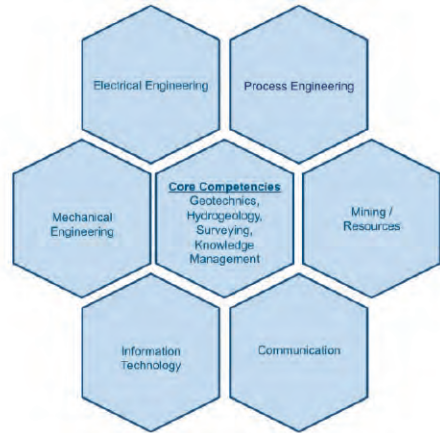
Preparations have to be put in place for the post-mining era. This means closing down the coal industry in an orderly fashion and sustainably managing the impact and legacy of decades of mining operations. Former mining sites and infrastructure will also have to be made available for practical development and utilisation projects. The Research Institute of Post-Mining sees itself as the central point for dealing with the complex issues that will arise after coal mining ceases: its role will be to pool existing knowledge, identify new areas of research and undertake research of its own. The regions, companies, administra-  
tive bodies and other institutions affected by the closure of the coal industry will therefore have a capable and independent point of contact to deal with.

The Research Institute of Post-Mining is an integral part of the University. While the Institute has its own set of specialist core skills, the diverse disciplines that are practised within the wider University – which has traditionally had a high mining content – help cre-  
ate an interdisciplinary network (Fig. 3). As a result, the complex issues associated with the post-mining society can be tackled in a multi- and interdisciplinary way, thereby providing the central platform for the Research Institute.

As well as having its own University-based interdisciplinary set-up the Research Institute also has access to a comprehensive network of mining and former mining companies, public authorities, water boards and regional associations, industry organisations, consultative and administrative bodies and higher education establishments (Fig. 4).

The Research Institute has a wide remit that essentially comprises the following activities:

- research,
- knowledge management and transfer,
- teaching,
- information and PR work and
- concrete working projects.



**Figure 3 / Interdisciplinary network supporting the Research Centre Post-Mining.**

Research is the main feature of the Institute's work, with the long-term liabilities left by the coal industry providing the special focus of attention. These activities are centred around the key problem of mine water, which creates a whole range of issues associated with rising water levels. Impact studies based on "Experiences with rising mine-water levels in the disused coalfields of Germany and Europe" (Melchers and Dogan 2014) are currently under way, this including an assessment of the flooding process as it affects certain individual areas. A survey is also being carried out of the bottom levels and water-bearing galleries of the Ruhr coalfield, along with separate investigations aimed at acquiring a temporal and spatial understanding of the density stratification in flooded mine shafts (Melchers et al. 2014; Melchers et al. 2015a). Innovative concepts for monitoring the rise in mine-water levels are also being examined and studies are under way into mine-water treatment and purification. Investigations are also being conducted into gas migration as mine-water levels rise and into the fun-



**Figure 4 / The Research Centre Post-Mining has access to a broad-based network of partners.**



Figure 5 / Conference ‘The POST-mining era in NRW’.

damental permeability of hydraulic barriers (Coldewey et al. 2014). The findings from this research work will help enormously in providing a record of rising mine-water levels and improving our basic understanding of this process.

The broad-based network also includes international contacts, as the challenges facing post-mining societies have a global relevance. There is now real interest in the global debate on the best approach to be used when closing a mining facility and ensuring transparency (Melchers et al. 2015b).

Preserving the intellectual heritage of the mining industry is another eternity task that has to be tackled and in this the Research Institute of Post-Mining sees itself as a central body for knowledge management and transfer. Mining know-how must be pooled, kept available and then passed on when required. This can be done through the medium of the master’s course “Geotechnical engineering and post-mining” as well as via specialist conferences, technical papers and public relations work. The third conference on “The POST mining era in NRW”, which was organised in conjunction with the Arnsberg District Government, was held in 2014 and attracted more than 200 participants. These conference events have focused on various themes (Fig. 5) and provided an important regional platform for information, interaction and communication. An intensive PR campaign is doing much to build a broader understanding of the issues involved, thereby objectifying the often heated debate surrounding the post-mining society in general and the problem of rising mine-water levels in particular.

## 5 Conclusions and outlook

Learning to adapt to the post-mining era has now been recognised as a fundamental challenge for most mining countries around the world. This applies especially to Germany as it prepares for the final closure of its coal industry. The transfer of knowledge from scientific and research work can create the basis for a competent response to existing questions and will also help identify future opportunities and provide support and assistance for their implementation. The University's Research Institute of Post-Mining is being funded jointly by the RAG Foundation, the regional government of North Rhine-Westphalia and the European Union. Its activities will ensure that the legacies of the mining industry are handled in a sustainable and responsible way and that the industry's intellectual heritage will be preserved, thereby opening up fresh prospects for the region as a whole.

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