The German Research Institute of Post-Mining

Vision and challenges
Agenda

• Research Institute of Post-Mining
• Research focus
• German Research Institute of Post-Mining
Research Institute of Post-Mining

Future since 1816
Coal Mining in Germany

Life cycle of Coal Mining

Pre-Mining (Exploration)

Mining

Post-Mining

Depleted field

Environmental Impact Risk Management

Short Period

Long Period

Eternity
Effects of abandoned and post-mining

- Operation areas
- Ground movement
- Surface openings
- Geological faults at the surface
- Gas emissions
- Polder areas
- Refuse dumps
- Pumping of mine water

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Research Institute

Guiding idea

The Research Institute of Post-mining offers independent, competent and sustainable solutions for the different post-mining tasks.

Mission

The Research Institute of Post-Ming develops the scientific basis for a sustainable mine water ascent in the coal mine regions at the rivers Ruhr, Saar and in the city of Ibbenbueren (Northern part of Germany).

Moreover, it is the major institution in knowledge management and transfer with regard to post-mining activities.
Research Focus

Risks and chances of the perpetual tasks
Research focus

• Mine water rebound in the coal mine regions Ruhr, Saar and in Ibbenbueroen
  • Characterisation of water-drainage adits
  • Density stratification in mine water bodies
  • Evaluation of mine water rebound processes
  • Separation of contaminants

• Monitoring concepts
  • Development of a mine water monitoring system
  • Innovative, satellite-bound monitoring of abandoned mines
  • Mineberry: Monitoring of former mine shafts

• Reuse of former mine sites
  • RE-ACTIVATE
Qualitative and quantitative characterisation of water-drainage adits
Qualitative and quantitative characterisation of water-drainage adits

Risk potential of old water-drainage adits in the Southern Ruhr area on human beings and environment

- Unknown location of the adits
- Unstable adits
- Water inrush
Qualitative and quantitative characterisation of water-drainage adits

- Documentation and inspection of more than 110 adits
- Database development
- Development of monitoring concepts

**Catchment area analyses:**
- Hydro-chemical analyses
- Catchment area on the surface
- Underground catchment area
- Water occurrence below the adit
Density stratification in mine water bodies of the Ruhr coalfield

Physical, chemical and hydraulic evaluation of natural density stratifications as contribution to an optimized long-term water management
Density stratification in mine water bodies of the Ruhr coalfield

Geophysical measurements and depth-differentiated sampling in abandoned shafts, groundwater monitoring wells and boreholes:

- Determination of temperature, conductivity, pH, O.R.P. and oxygen concentration with a multi-parameter probe
- Hydro chemical and isotope geochemical investigations

Sampling in active water drainage plants, mineral and curative springs/wells

Evaluation of density stratifications with regard to the geological conditions

Forecast of water quality evolution of ascending mine waters
Density stratification in mine water bodies of the Ruhr coalfield

Main characteristics:
- Independent of lithological or geological conditions
- No reference to water composition
- Boundary layer is just a few decimetre thick
- Irrespective of the level of flooding
- Exiting in stationary and instationary systems

Homogeneous conditions between boundary layers:
- Convective flow (e.g. due to inflow of higher mineralised water through underground openings)
- Triggering force: Geothermal gradient

Temperature-conductivity-Log of shaft Hermann 1 in Selm, Germany (Historical Data obtained from Kories et al., 2004)
Evaluation of mine water rebound processes

Coal mine regions in Germany

Coal mine regions in Belgium

Coal mine regions in Poland

Coal mine regions in France

Coal mine regions in UK

Systematic analyses of mine water rebound processes to obtain an in-depth knowledge in sequence and impacts
Evaluation of mine water rebound processes

- Formulation of the scientific base to assess the potential impact of mine water rise with the help of completed processes
- Development of principles and interdependencies during the mine water rise
- Transfer verification of the interdependencies to the Ruhr area

Potential impacts of mine water rebound
- Impact on water quality (including ground water aquifers)
- Ground movements
- Methane degassing on the surface
- Cave to the surface
- Hydraulic influence on ground water level conditions
- Development of water loggings (e.g. diked land)
Separation of contaminants from mine water

Development of discharge reduction measures of contaminants and separation of noxious particles from mine water

- Development of a chemical analysis for contaminants in suspension
- Model development for the separation of contaminants
- Result transfer to real mine water
Mine water monitoring system

Development and installation of underground measurement equipment to monitor the mine water ascent for middle- and long-term observation; pilot plant Auguste Victoria

**Determination of:**

- Measurement values
- Measurement locations
- Component requirements
- Development and/or adaption of the suitable components
- Development of the monitoring system
Mine water monitoring system

- Measurement locations and component requirements are defined
- Different systems measure the following parameter:
  - **Water**
    - pressure, temperature, conductivity, direction and velocity of the stream
  - **Air**
    - pressure and methane concentration
- Successful installation of the monitoring system
Joint monitoring of old mine workings

Development of a monitoring method for abandoned mines in the Ruhr area

• European Earth Observation Program *Copernicus* with the Sentinel satellites

• Satellite-bound monitoring for abandoned and post-mining activities

• With the aim of a joint monitoring concept for the Ruhr area

Field of application:
Ruhr area

5 mio. inhabitants on 4,000 sq km – hard coal mining since the 12th century – for 150 years in industrial scale…
Joint monitoring of old mine workings

Element determination for abandoned mines and their impact on the environment

Determination and selection of suitable monitoring methods

- Terrestrial
- Remote

Surface movements:

- Inspection
- Photography
- Terrestrial 3D-surveying: Levelling/Tachymetry/Laser-Scan
- Photogrammetry
- Remote sensing: UAS / UAV, airborne, satellite-bound
- Shaftberry
Mineberry: Monitoring of former shafts

Data
- Deep shaft measurement
- Rope switch
- Alerting an alarm
- GSM-communication

- (Visual inspection)
- Temperature measurement
- Ex and IP65 execution

Development of a regionally distributed monitoring system of abandoned mine objects

Shaft Richradt in Essen
Reactivation of old mine sites in the EU
Development of superior technologies and methods for the reuse of tailings ponds and waste dumps
• Establish a network of experts
• Development of superior technologies and methods to reactivate former mine sites
• Establish re-activation database (merge/enlarge existing EU-wide data)
• Best Practice
• Communication with stakeholder
• PR
Cooperation and project partner

Science

- Westfälische Wilhelms-Universität Münster
- TU Clausthal
- RUB

Enterprises

- RAG
- DMT
- EFTAS
- Wismut
- LMBV
- Littelfuse
- RWE
- Hygie-Institut des Ruhrgebiets

Authorities

- Bezirksregierung Arnsberg
- Rheinland-Pfalz
- Ziel2.NRW
- Europäische Union
- Geologischer Dienst NRW
- thyssenkrupp
German Research Institute of Post-Mining

Vision and challenges
Major Post-Mining Areas in Germany

- Coal mining areas
- Lignite mining areas
- Potassium, ore and spar mining areas
- Uranium ore mining areas
- Cavern areas
German Research Institute of Post-Mining

Competence cluster with entities active in post-mining
Mitigating environmental impacts (air, water and soil) and social issues
Converting brownfields into sustainable post-mining areas
Adapting remediation and rehabilitation technologies to local circumstances
Developing long-term monitoring concepts
Transferring knowledge and expertise
Thank you for your attention!

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