

2025-10-15

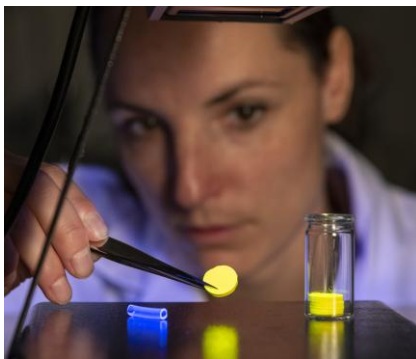
FEDERAL INSTITUTE FOR MATERIALS RESEARCH AND TESTING (BAM)

DIVISION 3.5 „SAFETY OF GAS STORAGE SYSTEMS AND TANKS FOR DANGEROUS GOODS”

Our mission: safety in technology and chemistry



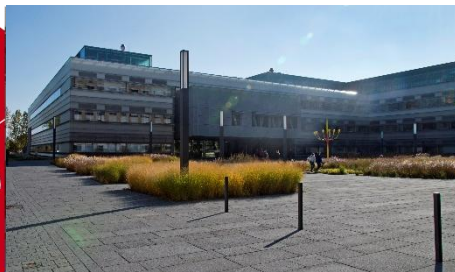
Federal Ministry
for Economic Affairs
and Energy



Our locations in Germany (Berlin and Brandenburg)



Fabeckstraße
Branch



Adlershof Branch



Lichterfelde Headquarters

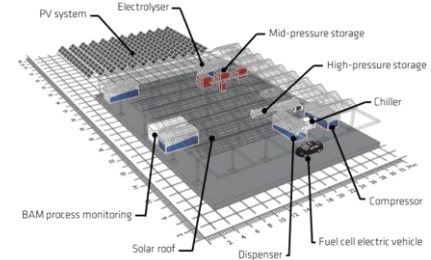
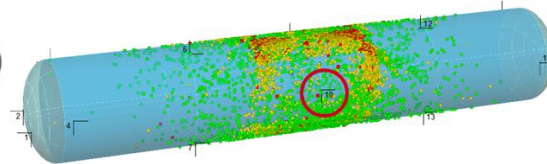
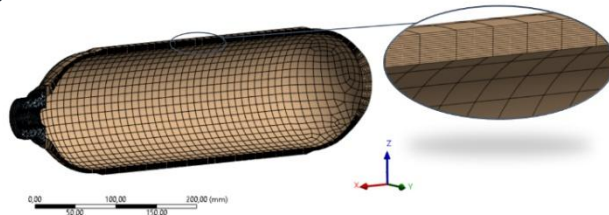


Test Site for Technical
Safety, Horstwalde

Division 3.5 - Safety of Gas Storage Systems

Areas of expertise

- Improvement and development of national and international regulations, codes and standards
- Probabilistic safety analysis with regard to probability of occurrence and risk
- Enabling **end-to-end digitization** from production to approval and operation to 2nd-life and end of life.
- Evaluation of composite gas storage systems with regard to their **lifetime determination**, in-service degradation and **operational stability**
- Numerical analysis, simulation and development of digital twins (e.g. H2 living-lab)



Division 3.5 - Safety of Gas Storage Systems

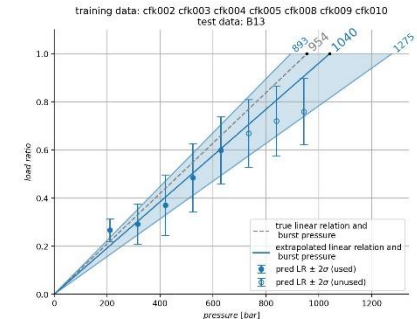
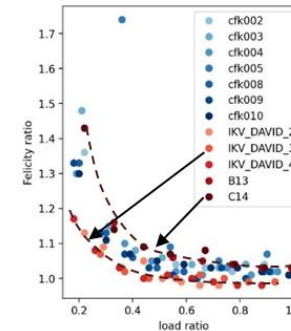
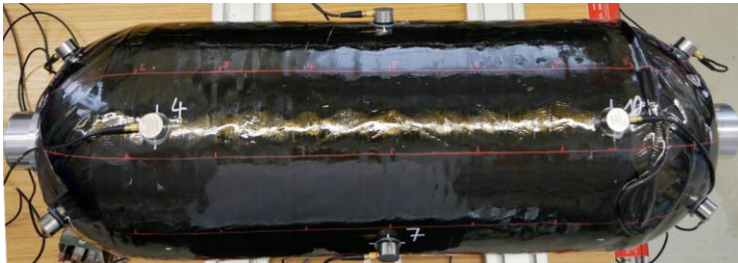
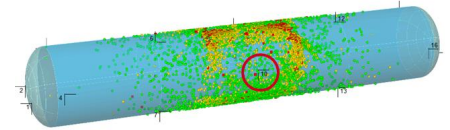
Areas of expertise

- Hydraulic and gaseous testing of gas storage systems with extensive measurement capabilities, especially for hydrogen applications
- Systematic development of destructive and non-destructive testing methods (mainly Acoustic Emission Testing)
- Investigation of accident scenarios in lab- or large-scale testing



Lifetime investigation of gas storage systems

- Assessment of the **operational safety** of gas storage systems throughout their entire life cycle taking into account manufacturing-related influences
- Monitoring of remaining service life and residual strength (Burst-pressure predictions with Acoustic Emission Testing)
- Damage localisation and failure mechanism detection using non-destructive testing methods, in particular acoustic emission analysis, applying machine learning and artificial intelligence methods

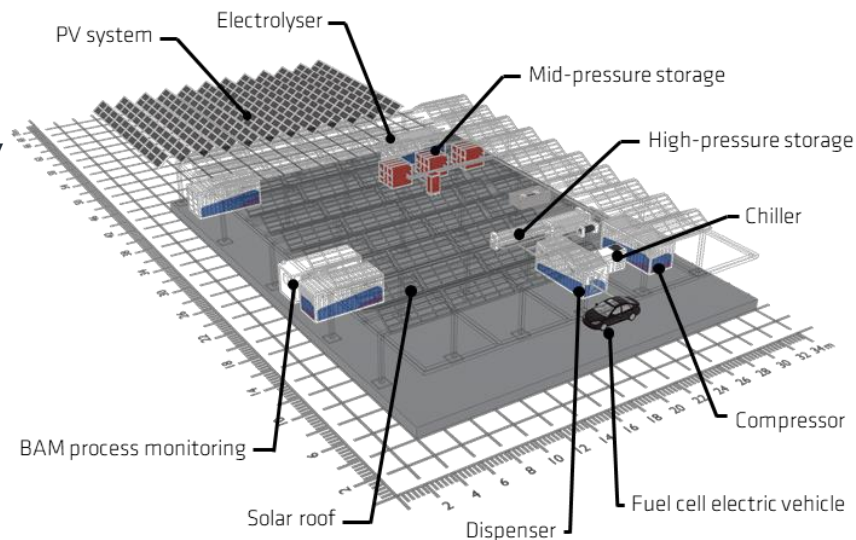


Living Lab Hydrogen Refueling Station

Application examples



- Testing and optimization of digitalisation tools for efficient quality assurance and online monitoring
- Increasing operational safety and availability of hydrogen plants through digital methods, new measurement techniques and direct data evaluation
- Development, testing and optimisation of new measurement techniques and data acquisition and processing methods for hydrogen plants



Features

- H₂-electrolysis (24 kg/day)
- H₂-storage (250 kg @ 200 bar, 60 kg @ 930 bar)
- H₂-chiller (-40°C)
- Dispenser for quick refueling FCEV
- PV-system (200 kW)

Unique-Selling-Points

- H₂-sensor network
- Gas quality sampling ports
- Prozess monitoring acc. to Industry 4.0
- IT-Infrastructure for QI-Digital tools, wide-area installation, structural protection
- Self-sustaining, green hydrogen
- Digital Twin with process modelling

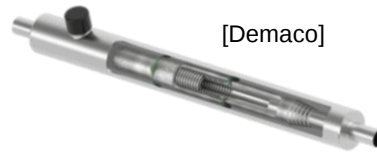


Liquefied Hydrogen (LH2) for the safe worldwide trade and mobility

- Medium volumetric energy density, free of carbon, and non-toxic to Hydrogen derivatives
- Application as fuel as well as for cooling (super conductors)
- Storages need tanks with thermal super-insulation
- Large-scale storage facilities were not built, yet
- Behavior of mobile, transport and stationary tanks in accidents and its consequences are less understood



[Airbus]



[Demaco]



[Air Liquide]

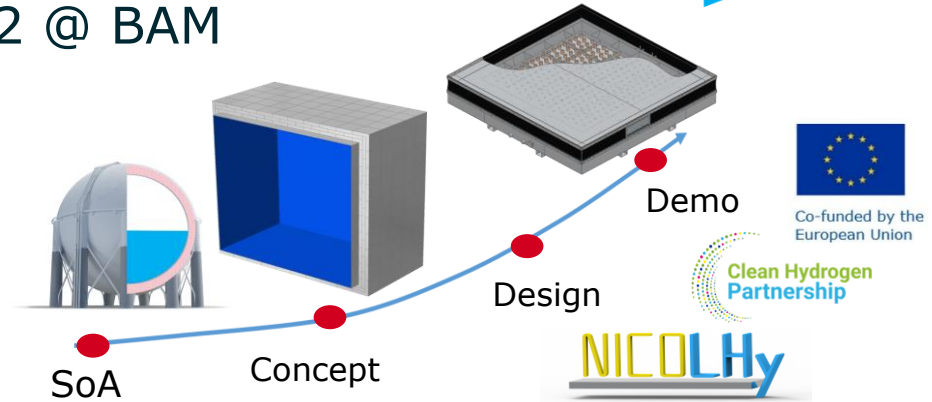
Liquefied Hydrogen (LH2)

Research Topics Related to LH2 @ BAM



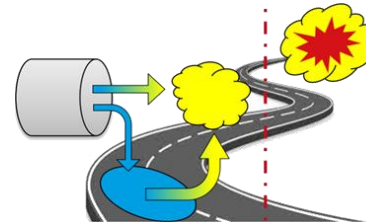
Thermal super insulations

- Cost and energy efficient,
- Highly scalable,
- Safe,
- For large scale applications



Sustainable implementation of LH2 as fuel

- Accident scenario investigations
- Tanks at extraordinary loads
- Material testing
- Recommendations, Codes, and Standards



Hydraulic testing of gas storage systems



- Internal load cycle testing
(up to 105 MPa, 10 loadcycles/min, Temp.: -50 to +90°C)
- Burst testing (up to 350 MPa, Temp.: 20 to +85°C)



- Creep rupture tests
(up to 350 MPa, Temp.: 20 to +85°C)
- Drop or Impact Testing
- Surface damage tests
- Chemical exposure



Gaseous testing of gas storage systems



- Localized or engulfing fire test (according e.g. GTR 13-2)



- High velocity impact tests (bullet penetration tests)
- High energy impact tests (crash scenarios investigations)
- Investigation of accidental behaviour



Thank you very much for your attention.

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Division 3.5 "Safety of Gas Storage
Systems and Tanks for Dangerous
Goods"

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