German Environment Agency

Umwelt Bundesamt

ENSOr 2020 - ONLINE

PFAS IN SOIL AND GROUNDWATER – NEW GUIDANCE FOR THE ASSESSMENT AND REMEDIATION MEASURES IN GERMANY

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Section II 2.6 / Soil Protection Measures

AGENDA

- ❑ **PFAS PROBLEMS IN GERMANY - A BRIEF STATUS**
- ❑ REGULATION AND ASSESSMENT CRITERIA
- ❑ PRACTICAL SUPPORT FOR AUTHORITIES
- ❑ SOURCE RELATED REMEDIATION AND MANAGEMENT OPTIONS
- ❑ ACCOMPANYING APPROACHES UNDER DISCUSSION
- ❑ LESSONS LEARNED AND OUTLOOK

Status quo in Germany

- **Incomplete data set** about the dimension in the total environment
- PFAS are not fully implemented into soil and groundwater monitoring networks
- Impacted sites: airports, fire fighters training areas, electroplating business and agricultural land
- Lack of standardized analytical investigation methods for PFAS and their precursors
- Legal binding value setting especially for drinking water, soil and groundwater are **still under development**
- Remediation options and management concepts are limited. They currently improving for groundwater and still in deficit for soil.

PFAS-Findings

- PFAS are detected in sea water, seabed and animals in the North and Baltic Sea. Samples taken near the coast are more contaminated than samples from the open sea. Many other measurements indicate that other PFAS also accumulate in waters.

- Groundwater in 15 German states is currently being examined for PFAS on specific occasions and detected at over 70% of the measuring points.

- PFAS can be detected in low concentrations everywhere in soils. PFAS that reach soils move with the seeping water into deeper layers and thus also reach the groundwater. This can happen very slowly if the PFAS (such as PFOA and PFOS) in the soil bind to particles. Then the transfer into the groundwater can take years to decades. Other PFAS are mobile and hardly bind to surfaces. Therefore, such PFAS are transferred more quickly into deeper soil layers and reach the groundwater faster.

- Some PFAS can also enter the food chain through uptake from the soil in plants and accumulate there. Even if PFAS-contaminated groundwater is used to irrigate agricultural land, PFAS can be absorbed by plants.

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Human Health Assessment – Germany

HUMAN BIOMONITORING PANEL

Based on an assessment of the literature on human epidemiological and animal studies the HBM-panel decided on **HBM I** values in **blood plasma;**

- **2 ng/ml for PFOA**
- **5 ng/ml for PFOS**

The HBM I value represents the concentration if a substance in a body matrix at and below which, according to the HBM Commission's current assessment, adverse health effects are not expected and therefore, no exposure reduction measures are necessary.

Human Health Assessment – Germany

HUMAN BIOMONITORING PANEL

If **the HBM-II** value is exceeded, a health impairment that can be considered relevant is possible for those affected, but need not occur.
The following HBM-II values have been established

- **For women of child-bearing age: 5 ng PFOA/ml blood plasma or 10 ng PFOS/ml blood plasma and**
- **For the other population groups: 10 ng PFOA/ml blood plasma or 20 ng PFOS/ml**

Plasma concentrations above the HBM-I level but below the HBM-II level indicate an exposure at which, according to current knowledge, effects can no longer be excluded with sufficient certainty.

PFAS related regulatory activities in Germany

- Different procedures in the German Federal States
- **National harmonized guidance is in preparation:**

Upcoming initiatives:

- Include precursors in the analytics as well (AOF, EOF, TOP-Assay)
- Monitoring and elaboration of background values
- HBM II implementation in order to indicate necessary and proportionate measures for related pathways and protected goods
- Use significant thresholds for assessing the groundwater contamination and soil eluates
- Pre-harvest monitoring may be considered, when agricultural land are affected
- Guidance on PFAS levels in soil for refill, backfill, reuse, landfill,…

Assessment of PFAS in groundwater and soil eluate

Substance	Significant thresholds for groundwater [µg/l]	Precautionary health-related indication value [µg/l]
PFBA	10	
PFPeA		3.0
PFHxA	6.0	
PFHpA		0.3
PFOA	0.1	
PFNA	0.06	
PFDA		0.1
PFBS	6.0	
PFHxS	0.1	
PFHpS		0.3
PFOS	0.1	
H4PFOS		0.1
PFOSA		0.1
other PFAS with R1-(CF2)n-R2, n›3		0.1

Von der Trenck et al., Environ Sci Eur (2018) 30, 19; Significant thresholds for the assessment of contaminated groundwater; perfluorinated and polyfluorinated chemicals

Backfill material categorized as Z classes according to the German soil classification (in µg/L)

	Z0	Z1	Z2
PFBA	‹10.0	10.0	50
PFHxA	‹6.0	6.0	30
PFOA	‹0.1	0.1	1
PFNA	‹0.06	0.06	0,6
PFBS	‹6.0	6.0	30
PFHxS	‹0.1	0.1	1
PFOS	‹0.1	0.1	1
PFPeA	3.0	3.0	15
PFHpA	0.3	0.3	3
PFDA	0.1	0.1	1
PFHpS	0.3	0.3	3
H4PFOS	0.1	0.1	1
PFOSA	0.1	0.1	1
Other PFAS	0.1	0.1	1

Main idea:
PFAS contaminated soil should not be landfilled/backfilled/used at places with no or a lower PFAS pollution.

- **Z0:** considered as not contaminated
  → no limitations for use
- **Z1:** emplacement with limitations
- **Z2:** storage, landfill only with defined technical measures

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Research project: “Remediation and management options for PFAS contamination”

- Contractor ARCADIS Germany GmbH (PL Dr. Held)
- Duration 2017-2019
- Integration of a project steering group with experts from the German Laender and from Switzerland
- Two parallel subject-related project lines for point sources and large scale pollution patterns with specific workshops and stakeholder involvement.
- Online-publication in June 2020
- English translation foreseen

Project Outcome

- **Overview of currently available remediation technologies for soil and groundwater;**
- **Assessment of prerequisites, technical feasibility and proportionality of the practical use of approaches for the remediation of PFAS-contaminated sites and for the handling and disposal of contaminated soil material and residual fractions;**
- **Brief description and fact sheets on PFAS-substances and remediation technologies.**

- Specific chapters describe the remediation of point sources as well as special features for areal contamination;
- Current situation of the circular economy related to PFAS
- Recommendations for improving public relations.
- Appendices contain detailed information about:
  - PFAS substance group;
  - Applied assessment methods and criteria;
  - Remediation techniques, other related measures and management options
  - Selected case studies;
  - Further research need within their complexity.

Legal regulations/approaches applicable for large scale contamination in soil and groundwater

- Application of an integral remediation plan
- Designation of areas with adapted regulations (legally admissible under the German Soil Protection Act)
- Experiences so far in traditional mining regions with increased background values by using:
  - Limited or predetermined use of affected soils and materials
  - Capping, Planting, prohibited applications of determined substances
  - (Soil) -investigation on a regularly basis
  - Binding regime for excavated soils and landfilling
- Cadaster documentation of affected areas
- Management of excavated soils for recovery or disposal
- Consideration for large scale pollution within regional and spatial planning
- Action plan as a steering tool for a targeted approach within municipalities.

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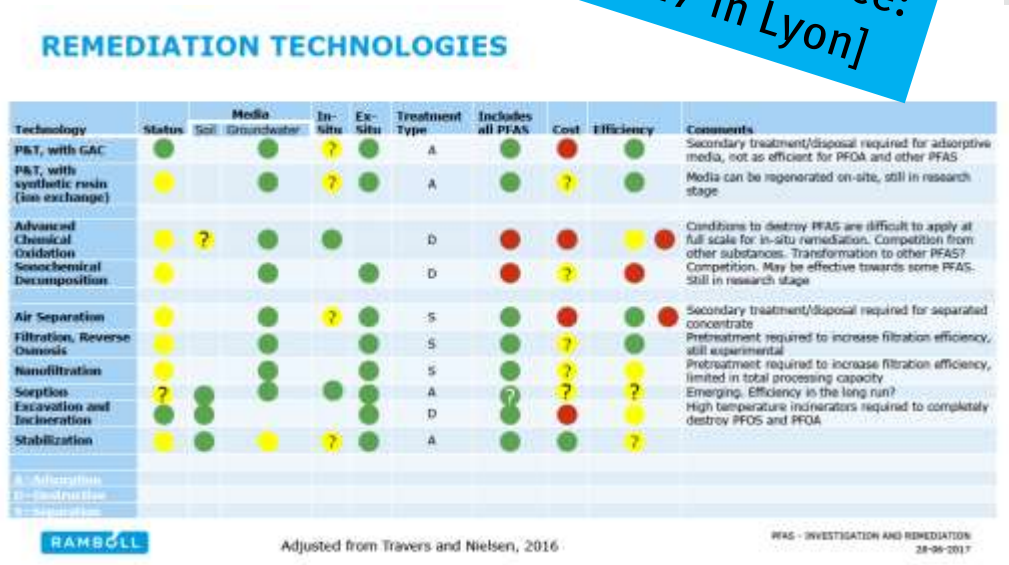
Current state of applicable remediation techniques

- Dig and Dump and Pump & Treat are still the most frequent used technologies
- Other alternatives are arising on the horizon
- All conventional and emerging technologies have not been checked for their efficiency for precursors!
- Manufacturer independent technology evaluations are lacking in most cases
- Cost-efficiency also still needs to be shown
- **However, in the overall assessment of management approaches for PFAS-contaminated sites, remediation technologies representing one important criteria only.**

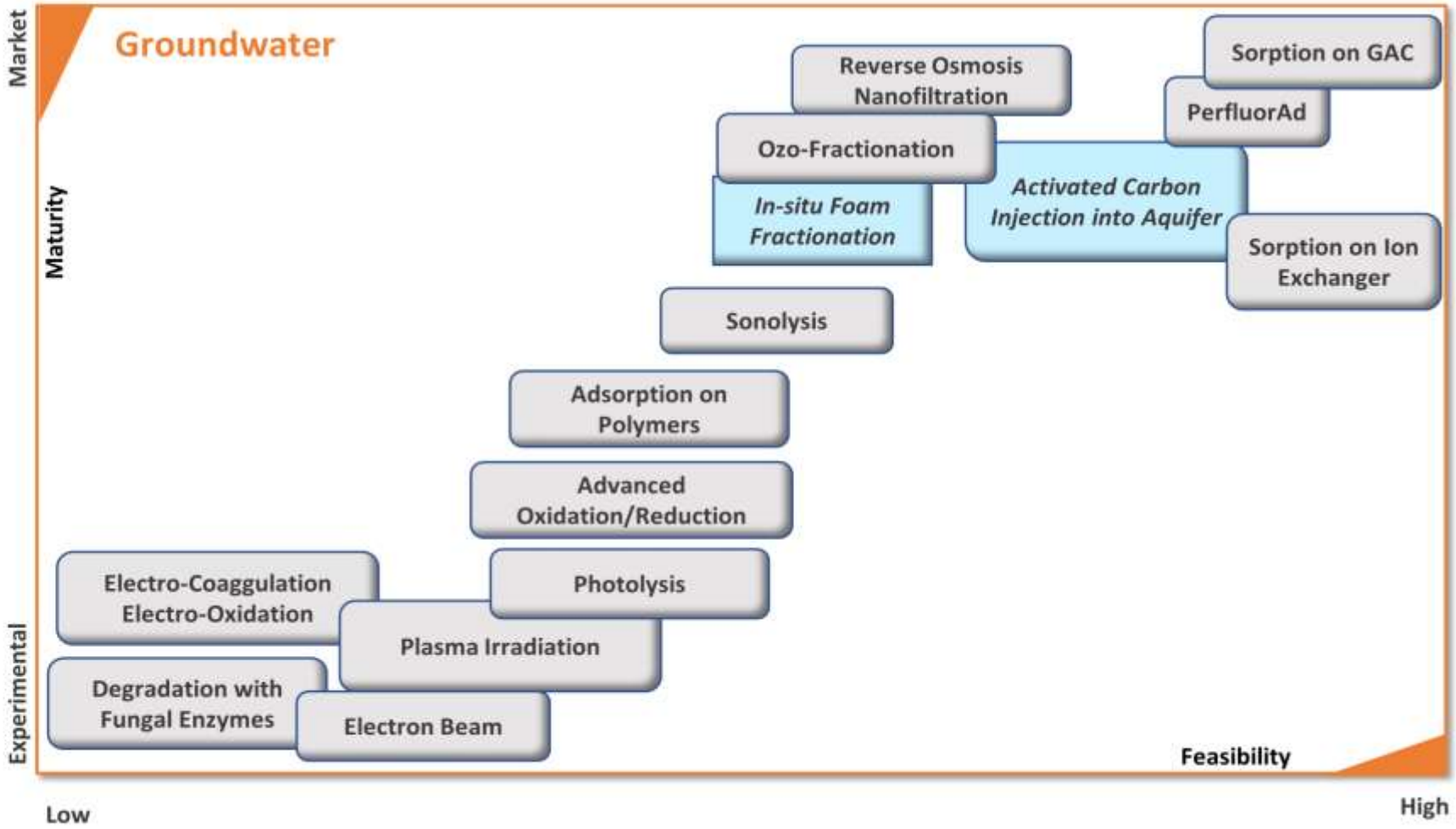
Expert opinion by Ramboll about applicability of remediation options [Source: AquaConSoil 2017 in Lyon]



Groundwater Remediation Technologies

based on Pump-and-Treat

Applicability in situ

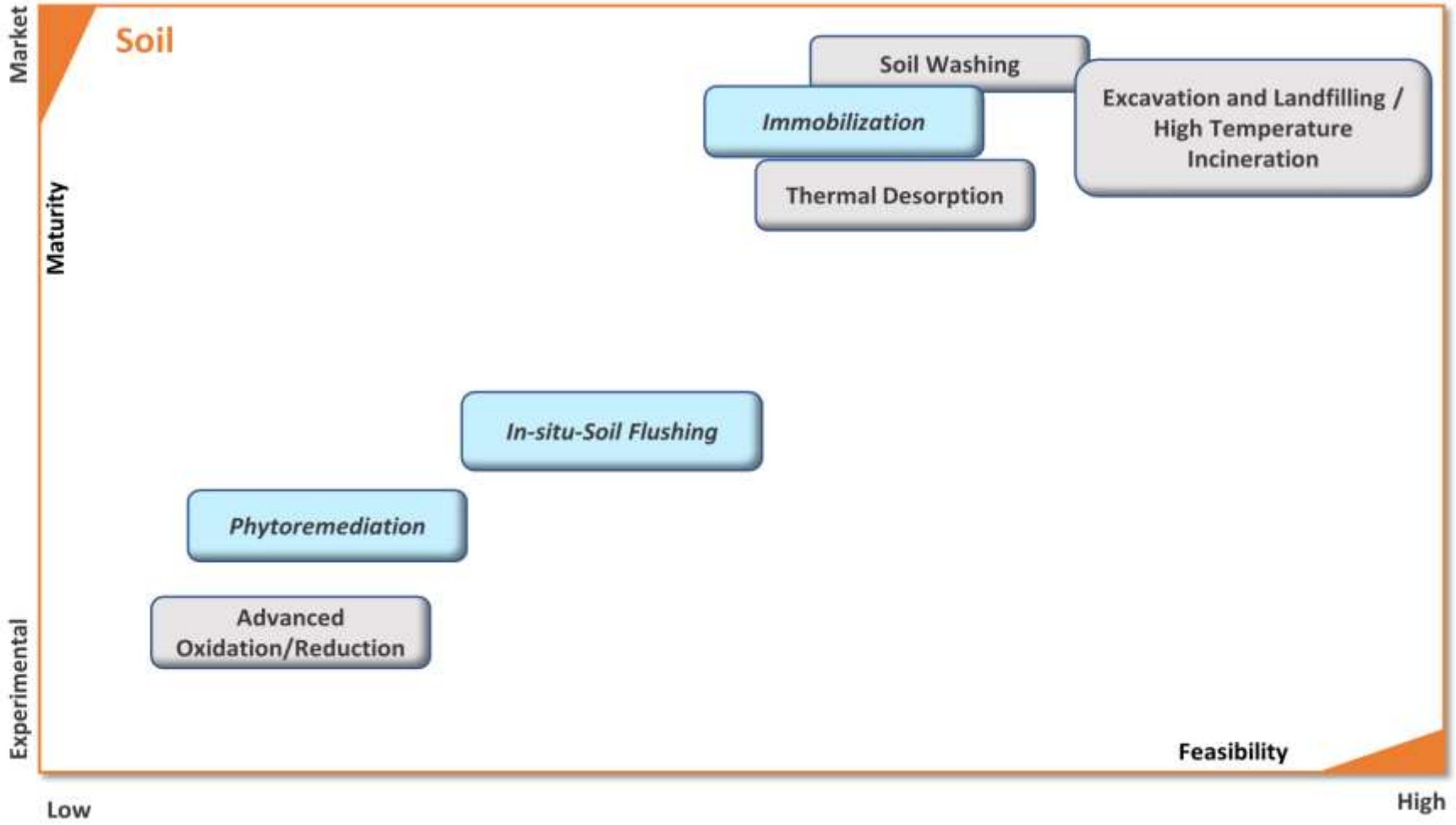


Soil Remediation Technologies

based on soil excavation

ARCADIS Design & Consultancy for natural and built assets

Applicability in situ



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Prevention

- Improvement for registration and regulation of PFAS!
- Further developments in analytical detection, monitoring and food safety!
- Strengthening prevention in the environmental policy!
- Public awareness, communication and changes in behavior of consumers!

Demands from the stakeholder discussion

- Principle for the further application of PFAS: **“As less as possible and as much as necessary”**
- Exit from the fluorine chemistry - exceptions just in cases of necessity and if there are no alternatives!
- Improvement of registration procedures - Plant protection registration in Germany is seen as a model.
- A public debate about the involvement of producers and waste producers in remediation costs.

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Lessons learned and take home messages

- Restriction of non-essential PFAS-uses under REACH
- Improvement of analytics and monitoring in environmental media
- Setting legally binding values
- More integrated research also on remediation and clean up and their sustainability
- Building on alternatives!
- Think globally!
- Information for consumers

Quick transfer of applied research findings with a “suitable translation” for practical and administrative implementation.
Development and implementation of (innovative) remediation measures with (based on sufficient experiences and verified treatment techniques , approved as well as accepted management concepts)

- **A “future” approach is crucial - How to deal with emerging pollutants to reduce the delay between first indications and appropriate environmental protection measures?**

Acknowledgement:
Thanks to my co-worker Annegret Biegel-Engler and to the contractors Dr. Thomas Held and Dr. Michael Reinhard from Arcadis Germany GmbH

Thank you for listening, any questions?

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