

FIELD EXPERIENCE OF IN SITU PFAS REMEDIATION TECHNIQUES

Loïc Ruiz | 19 June 2026 | Paris, France



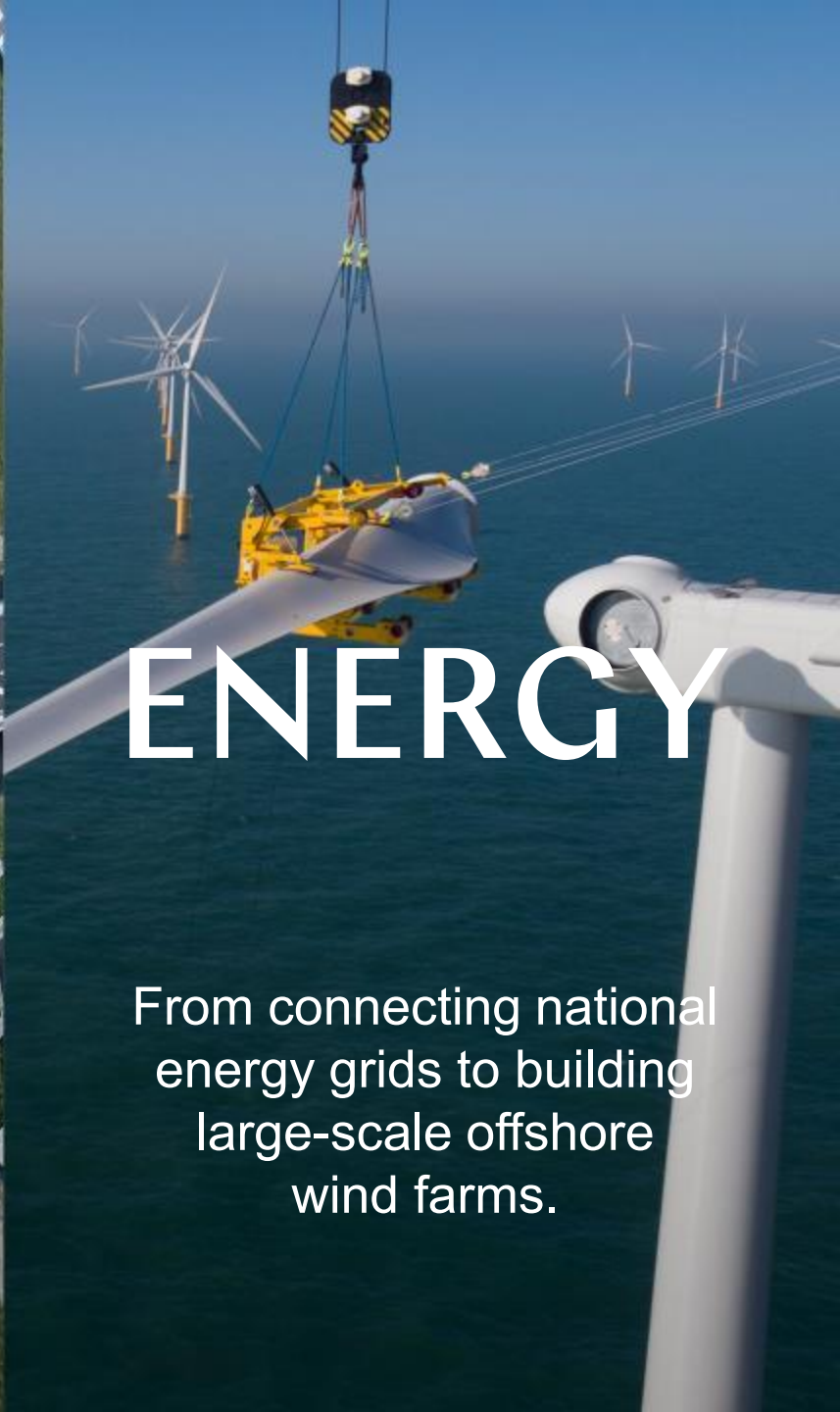
WATER

From developing the world's most vital waterways to protecting our delicate shores.



LAND

From carrying out ingenious construction projects to breathing new life into contaminated sites.



ENERGY

From connecting national energy grids to building large-scale offshore wind farms.

Expertise

MARINE WORKS IN FRANCE



HARBOR CONSTRUCTION

Dunkerque LNG, Port of Calais, ...

Jan De Nul participated in the construction of **70%** of **France's ports**.



WIND FARM INSTALLATION

Saint-Nazaire Offshore Wind Farm (EDF), ...

Jan De Nul contributed to the installation of **every wind farm** in **France** to date.



CABLE LAYING

Long term contract with RTE

Expertise

2015

+10 years R&D work on
PFAS remediation

8

valorisation centres in
Belgium and France

+1 M

tonnes of PFAS soil treated

+2 M

m³ of PFAS water treated

PLANET REDEVELOPMENT

SOIL WASHING

On site – or at one of our
valorisation centres



Toulon (FR)



Ghent (BE)



Liège (BE)

PFAS SOIL TREATMENT



SOIL WASHING

Efficient, high TRL
Not all soil types



THERMAL TREATMENT

Complete destruction
Energy cost



LANDFILL

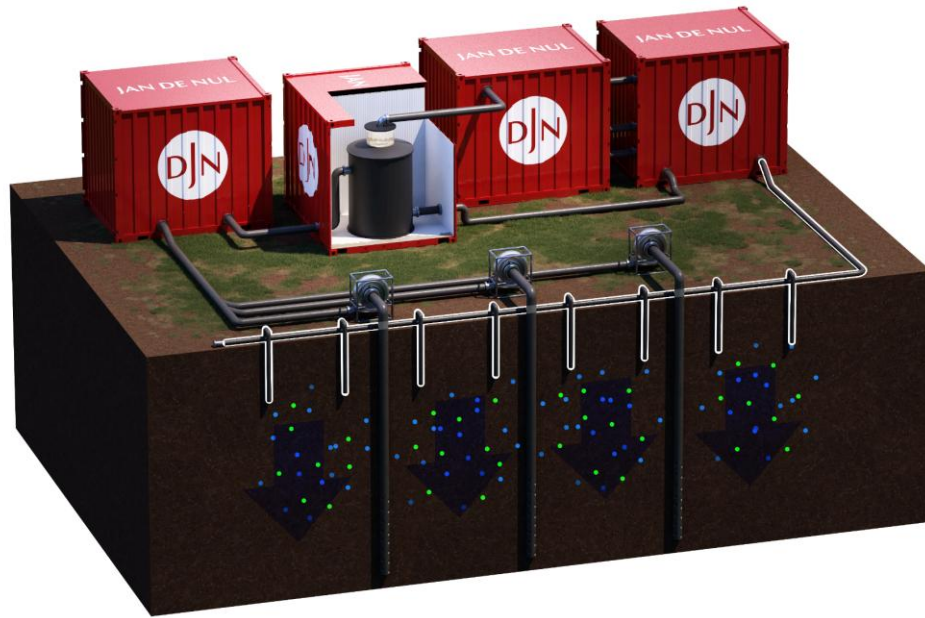
Heavily contaminated streams
Capacity, leachate



IN SITU TECHNOLOGIES

No excavation
On site

IN SITU REMEDIATION TECHNIQUES

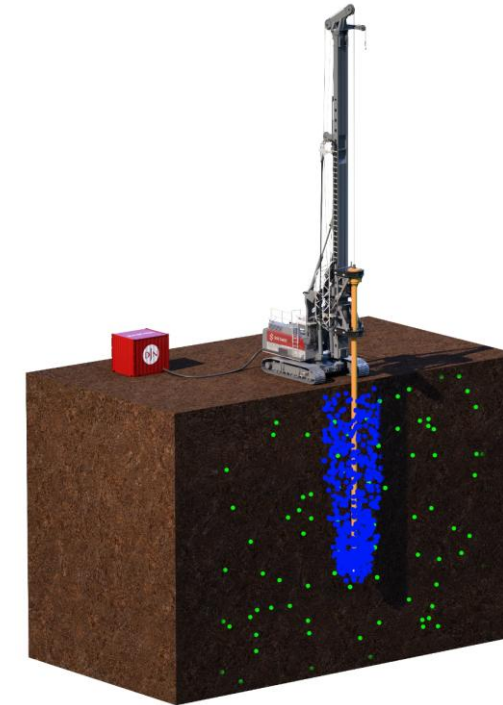


SOIL FLUSHING

= PFAS removal from soil

FOAM FRACTIONATION

= water treatment + concentration of PFAS



IMMOBILISATION

= in situ confinement

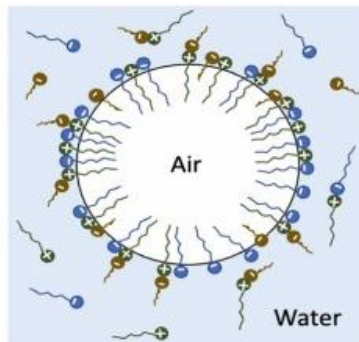
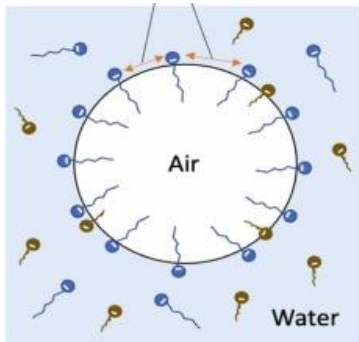
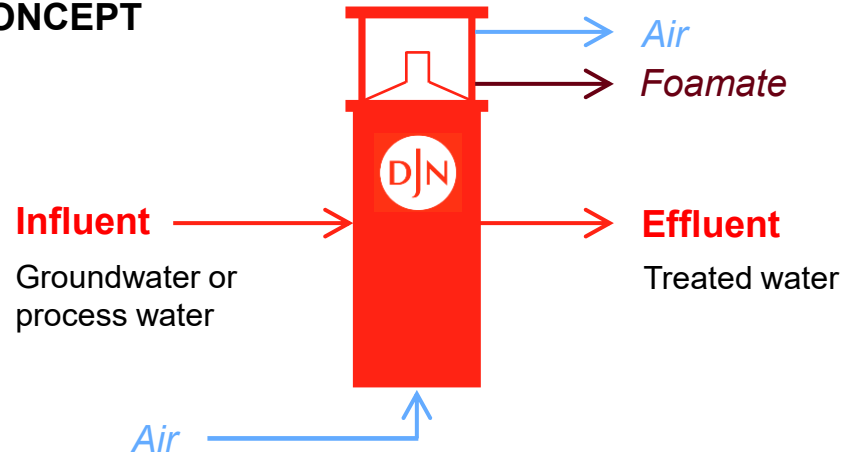
SOIL FLUSHING

FOAM FRACTIONATION



FOAM FRACTIONATION

CONCEPT



Reprinted from A.C.E. We et al. (2023)

TEST UNITS

- Semi-lab scale
300 L/h
- Pilot scale
10 m³/h

FOAMATE TREATMENT

- Destruction technologies
- Activated carbon

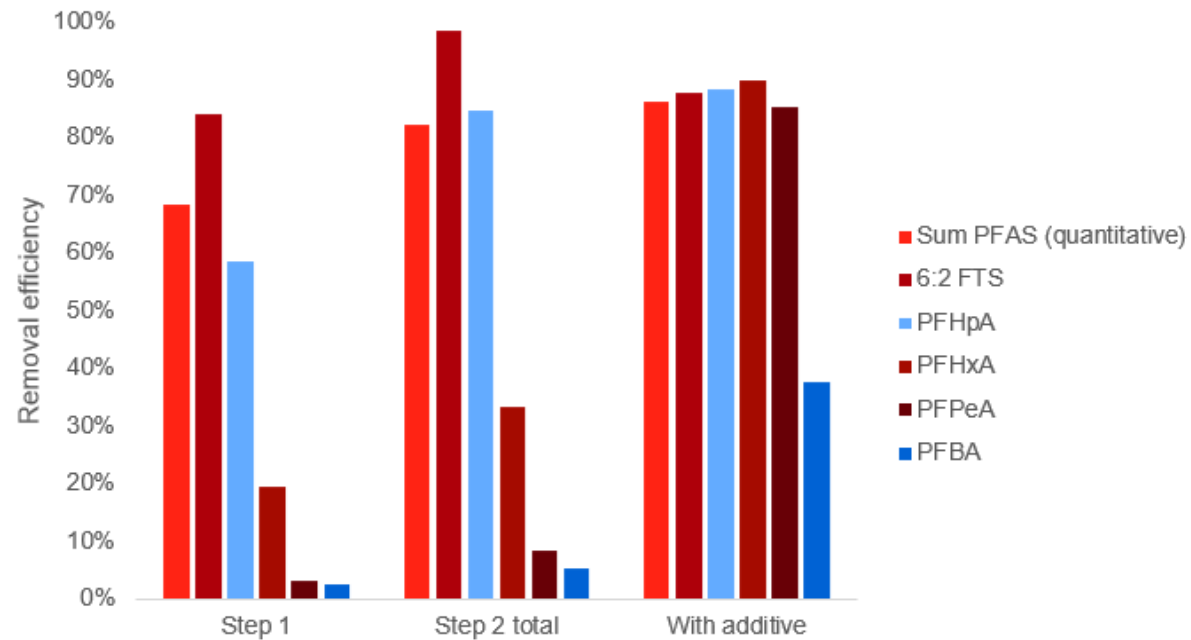
Experimental results

FOAM FRACTIONATION



LAB TESTS

- Continuous system
- Flow rate = 300 L/h
- Foaming additives
- Simple vs double passage



Pilot project. KIS p-FRESCO

Port of Antwerp (BE), 2025–2026

30–45
µg/L

average
PFAS concentration

5–10
m³/h

flow rate

+5000
m³

of groundwater
treated

Groundwater contamination

- Originates from firefighting foams
- 6:2 FTS, PFHxA, PFBA

Foam fractionation unit

Design | Engineering | Construction by Jan De Nul

- Autonomous
- Modular
- Remote follow-up and operation

FOAM FRACTIONATION

KIS Knowledge centre
Innovative remediation
Solutions

WE MAKE
TOMORROW
BEAUTIFUL
OVAM

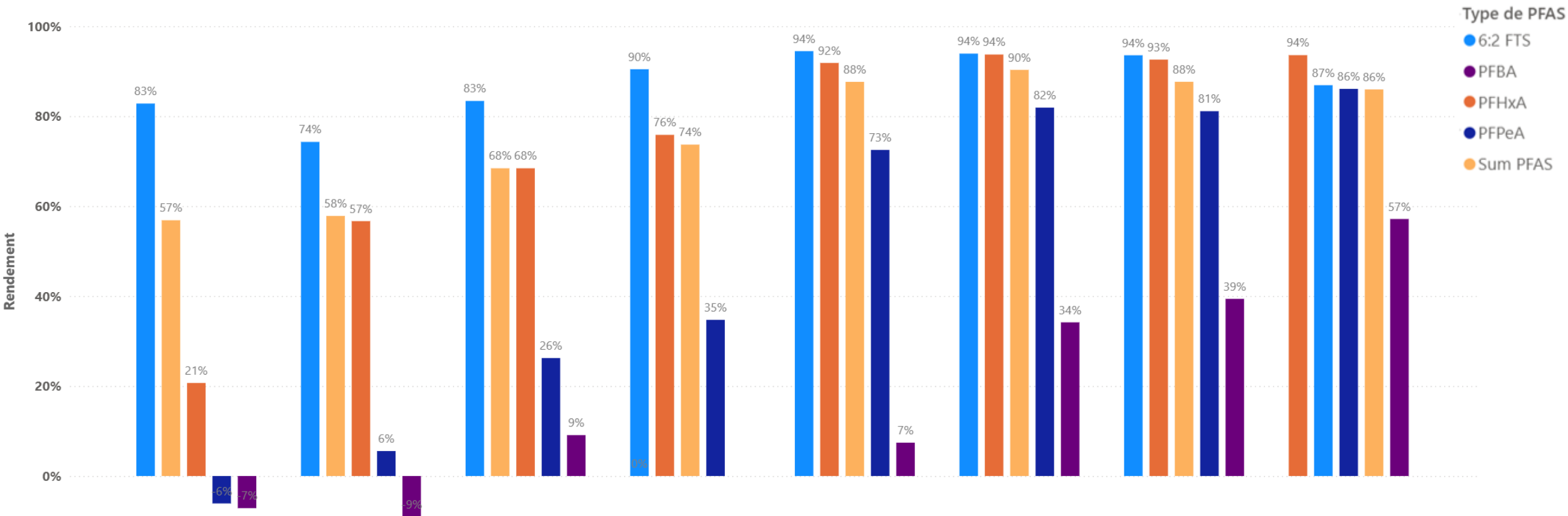
DJN JAN DE NUL



Pilot project. KIS p-FRESCO

Port of Antwerp (BE), 2025–2026

FOAM FRACTIONATION

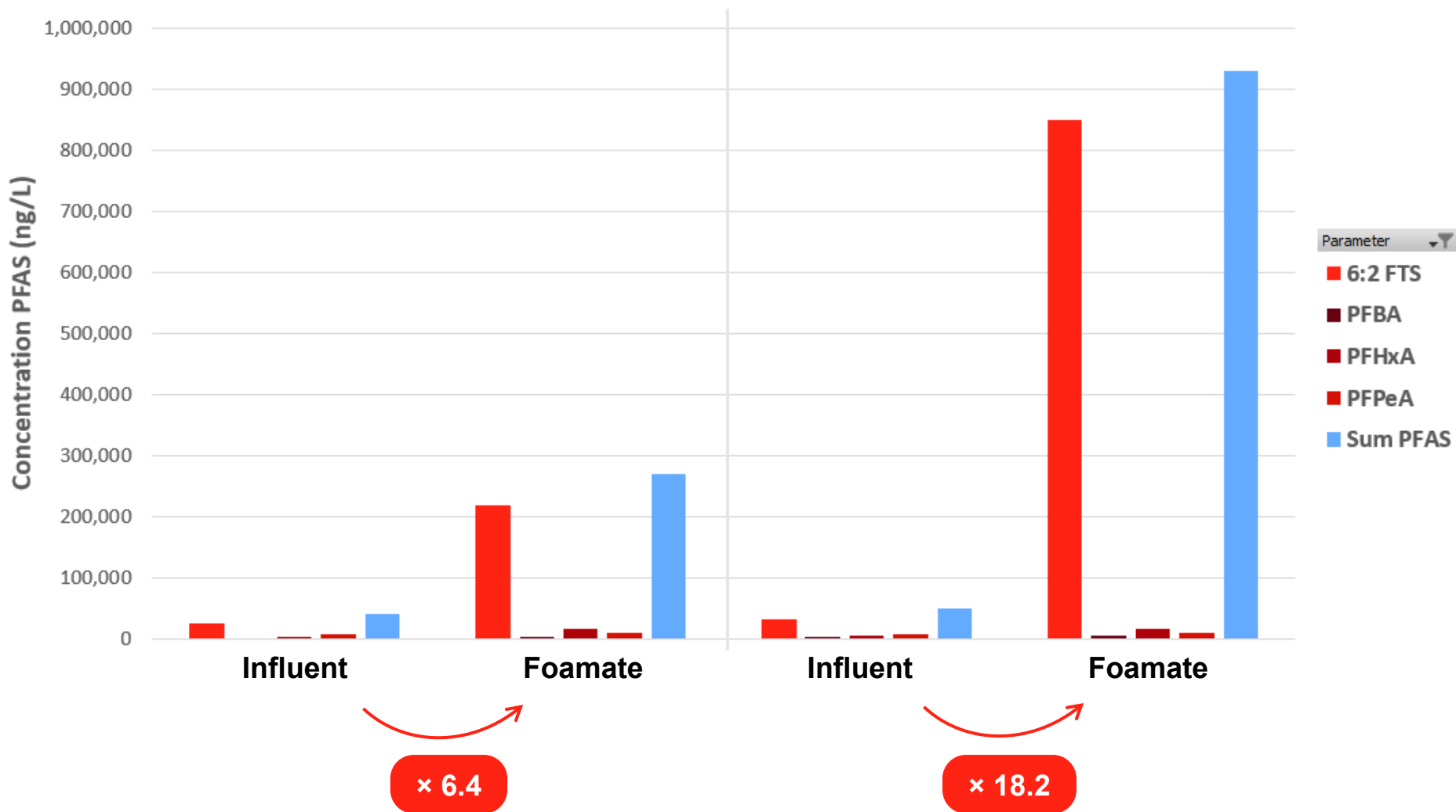


Dosing rate of foaming agents

Pilot project. KIS p-FRESCO

Port of Antwerp (BE), 2025–2026

FOAM FRACTIONATION



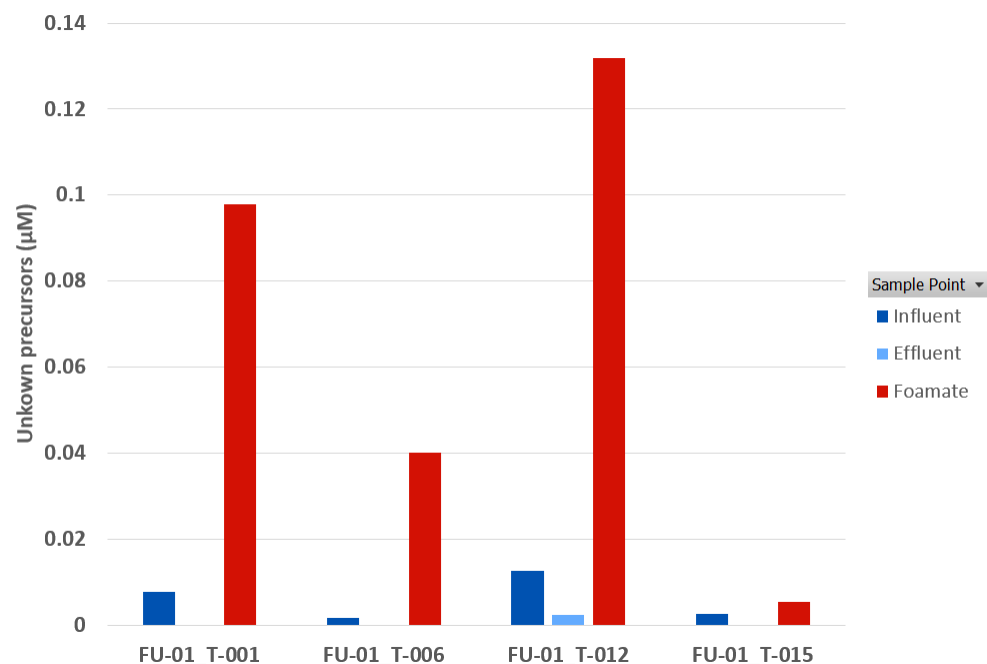
Pilot project. KIS p-FRESCO

Port of Antwerp (BE), 2025–2026

FOAM FRACTIONATION

Total Oxidizable Precursor Analysis

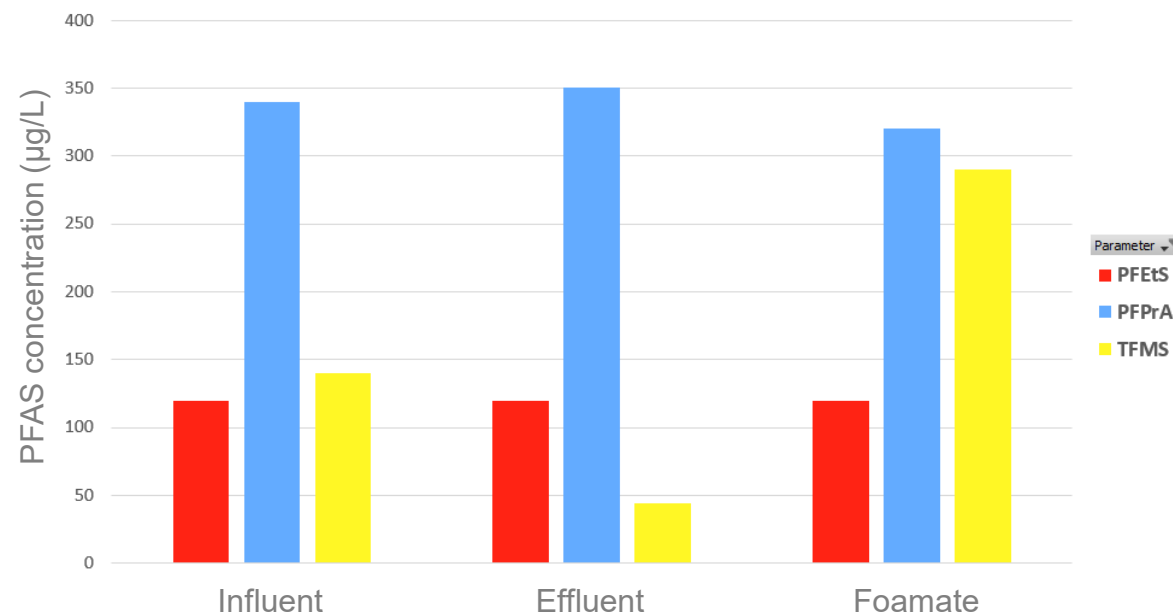
= indication of “unknown” PFAS precursors



Unknown PFAS precursors
are concentrated in the foamate

Ultra short chain PFAS

< 4 carbon atoms (very water soluble)



Not yet suitable for removal
of ultra short chain PFAS

SOIL FLUSHING

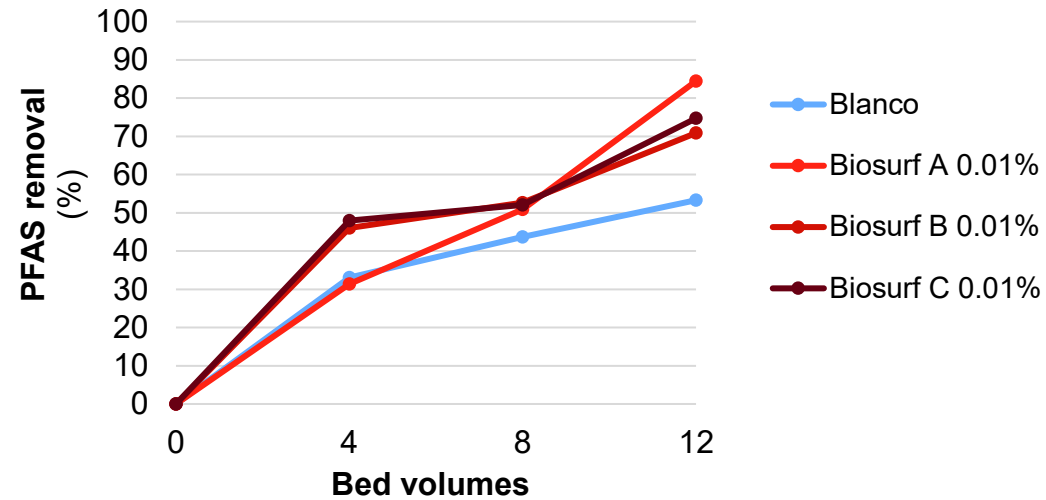


Experimental results

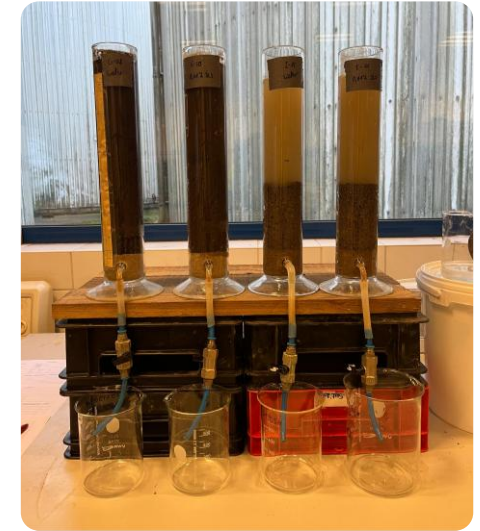


LAB TESTS

- Flushing flow rate
- PFAS removal in function of:
 - Type biosurfactant
 - Dosing rate biosurfactant
 - Flushing volume

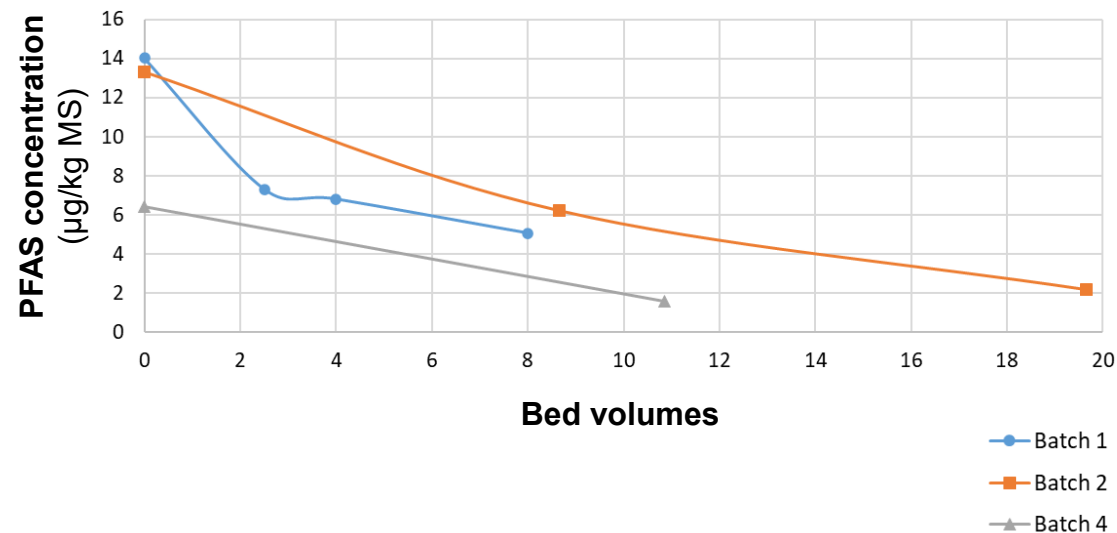


SOIL FLUSHING



EX SITU PILOT TESTS

- Pilot validation of
 - Flow rate
 - PFAS removal



Pilot project. LIFE PFASTER

Former paper mill factory in Antwerp (BE), 2026–2029

10–100
µg/kg MS

soil PFAS concentration

1
m³/h

flow rate

July
2026

start of pilot test

SOIL FLUSHING

- Biosurfactants: mobilizing agents
- DeepFlow™: injection of biosurfactants
- 100% recirculation (no discharge point)

FOAM FRACTIONATION

- Biodegradable foaming additives

SOIL FLUSHING + FOAM FRACTIONATION



IMMOBILISATION



Immobilisation principle

IMMOBILISATION

OBJECTIVE

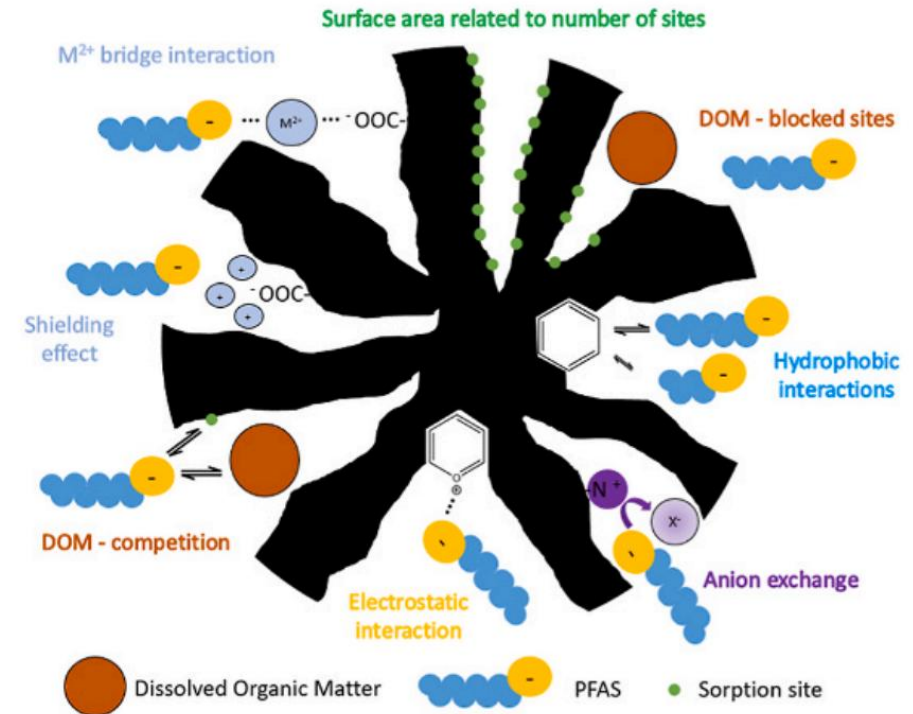
Immobilisation (stabilisation) of PFAS in the soil matrix

- Jan De Nul additive
- Other additive suppliers

RESULT

- Reduction of PFAS leaching
- Reduction of PFAS mobility in groundwater
- Risk management

IMMOBILISATION MECHANISM



Reprinted from Fabregat-Palau et al. (2022)

Methods of application

IMMOBILISATION



DeepFlow™ injection



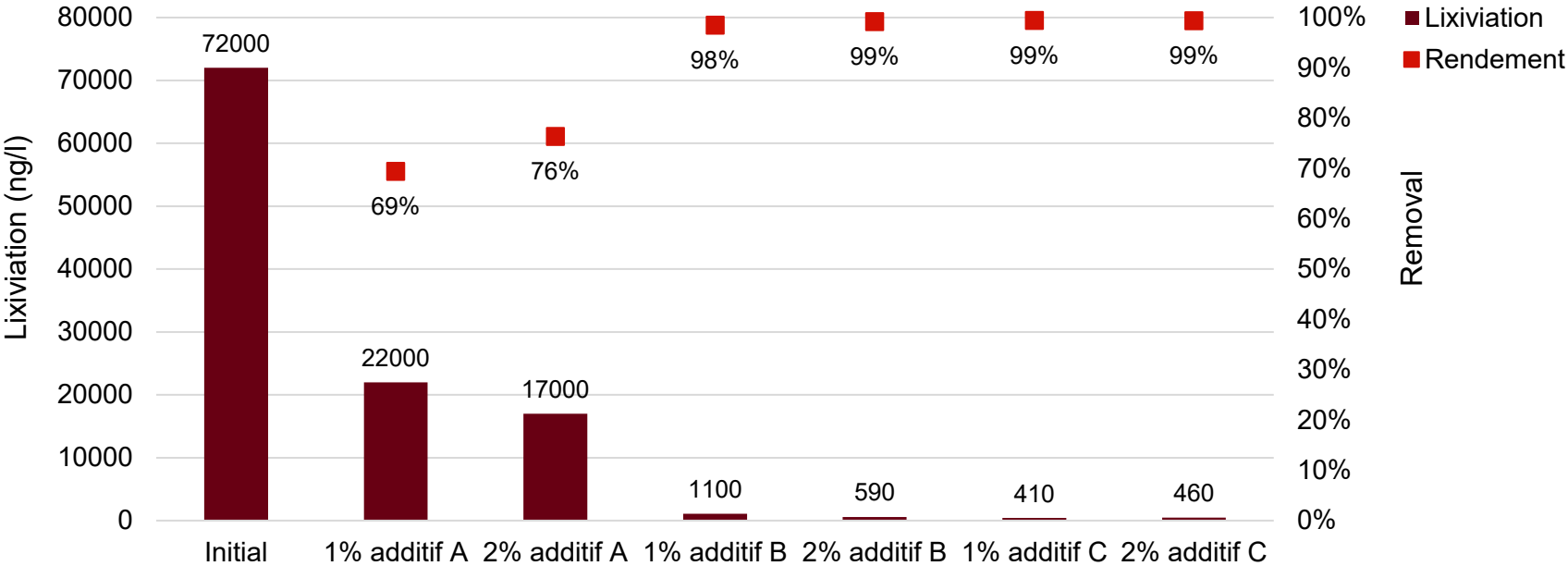
Soil mixing

Experimental results

IMMOBILISATION



BATCH LEACHING TESTS



Pilot project. KIS PIGGS

Port of Antwerp (BE), 2025–2027

KIS Knowledge centre
Innovative remediation
Solutions

anteagroup

DJN JAN DE NUL

IMMOBILISATION

42
µg/kg MS

soil PFAS concentration

8900
ng/L

groundwater
PFAS concentration

12
m²

treated in pilot

6

months of monitoring
to date

IMMOBILISATION ADDITIVE

- Developed by Jan De Nul

INJECTION TECHNIQUES

- DeepFlow™ injection
- Soil mixing



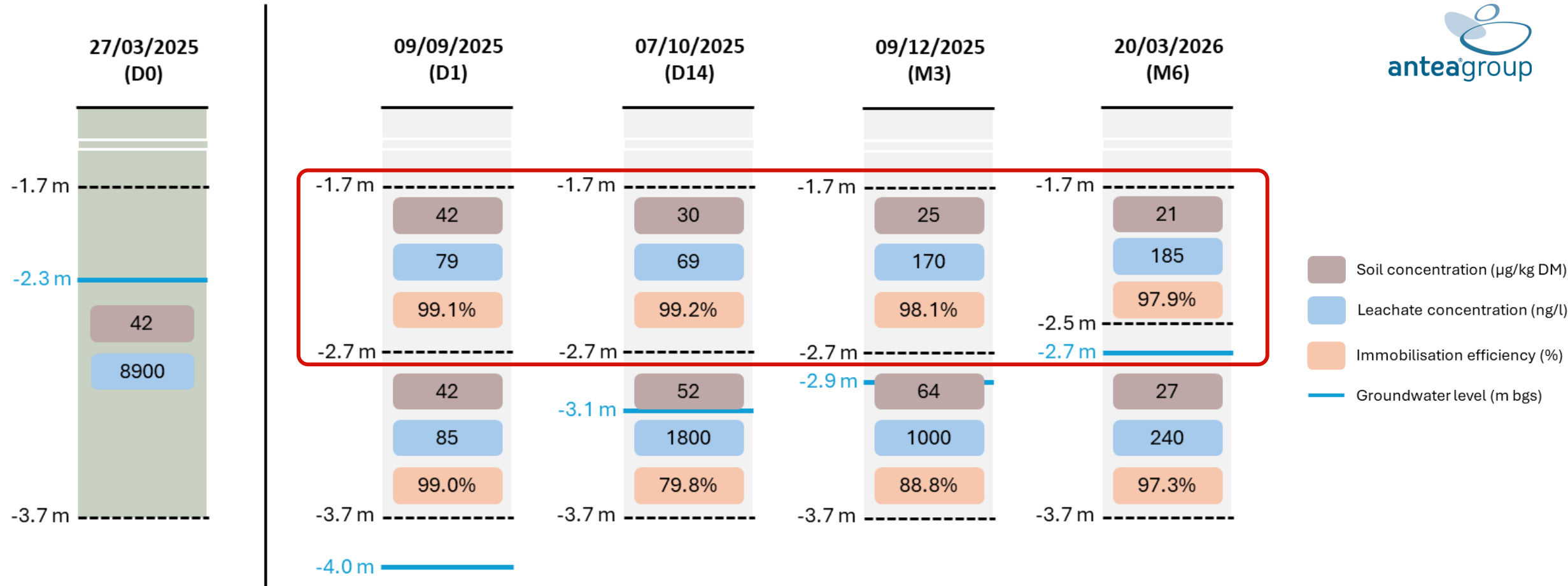
Want to know more?



Pilot project. KIS PIGGS

Port of Antwerp (BE), 2025–2027

IMMOBILISATION



Stable PFAS immobilisation of 98% - 99% in the pilot test (current follow-up of 6 months).

Field experience. Injection techniques

IMMOBILISATION

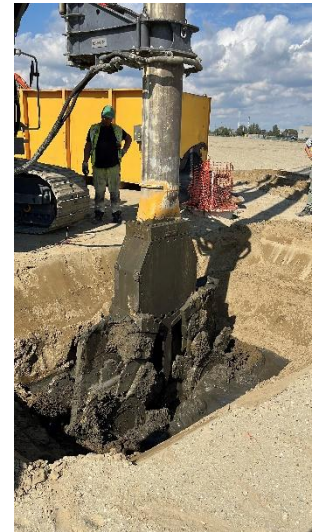
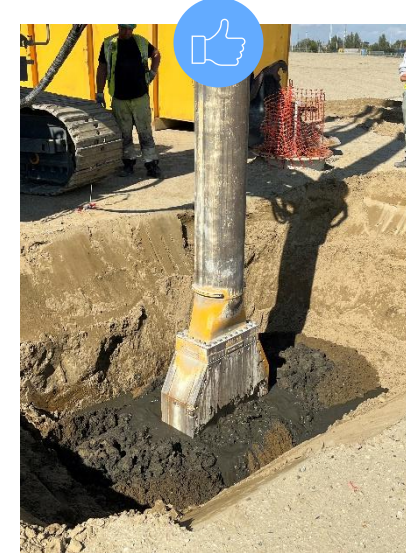
DeepFlow™ injection

- Soil permeability
- Additive solution solubility
- +70 m depth
- Applicable inside buildings, warehouses, ...

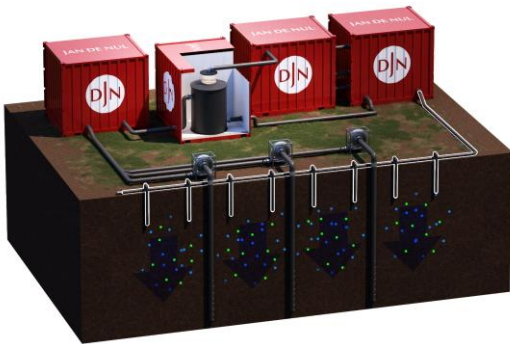


Soil mixing

- Less sensibility to soil permeability
- Additive solution solubility
- +30 m depth
- Soil surface must be uncovered



TECHNOLOGY EVALUATION



	Soil washing	Soil flushing	Immobilisation
Risk mitigation	+++	++	+++
Mass removal	+++	+++	-
No excavation necessary	-	++	+++
No residual fractions	+	++	+++
Major cost	CAPEX & OPEX	CAPEX & OPEX	OPEX
Maturity	+++	++	++

ENDNOTE

Soil washing

Our mature, proven remediation technology for PFAS contaminated soils.

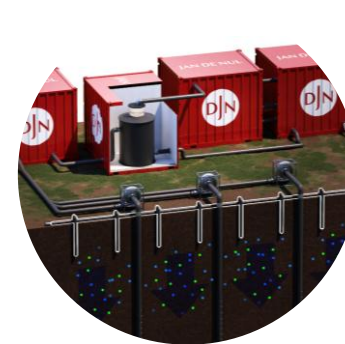


In situ technologies

For situations where site conditions limit the feasibility of excavation or washing.



Immobilisation



Soil flushing



Containment

NO ONE-SOLUTION-FITS ALL

Through lab and pilot-scale testing, we help to engineer a site-specific solution.

WE TRANSFORM POLLUTED SITES INTO OPPORTUNITIES FOR DEVELOPMENT OR NATURE RESTAURATION



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