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INTERSOIL 2026 · BARCELONA · PFAS DAY

Scaling fungal biofiltration for concentrated **PFAS** streams

From site-specific bioprospecting towards an onsite pilot at Willebroek, Belgium

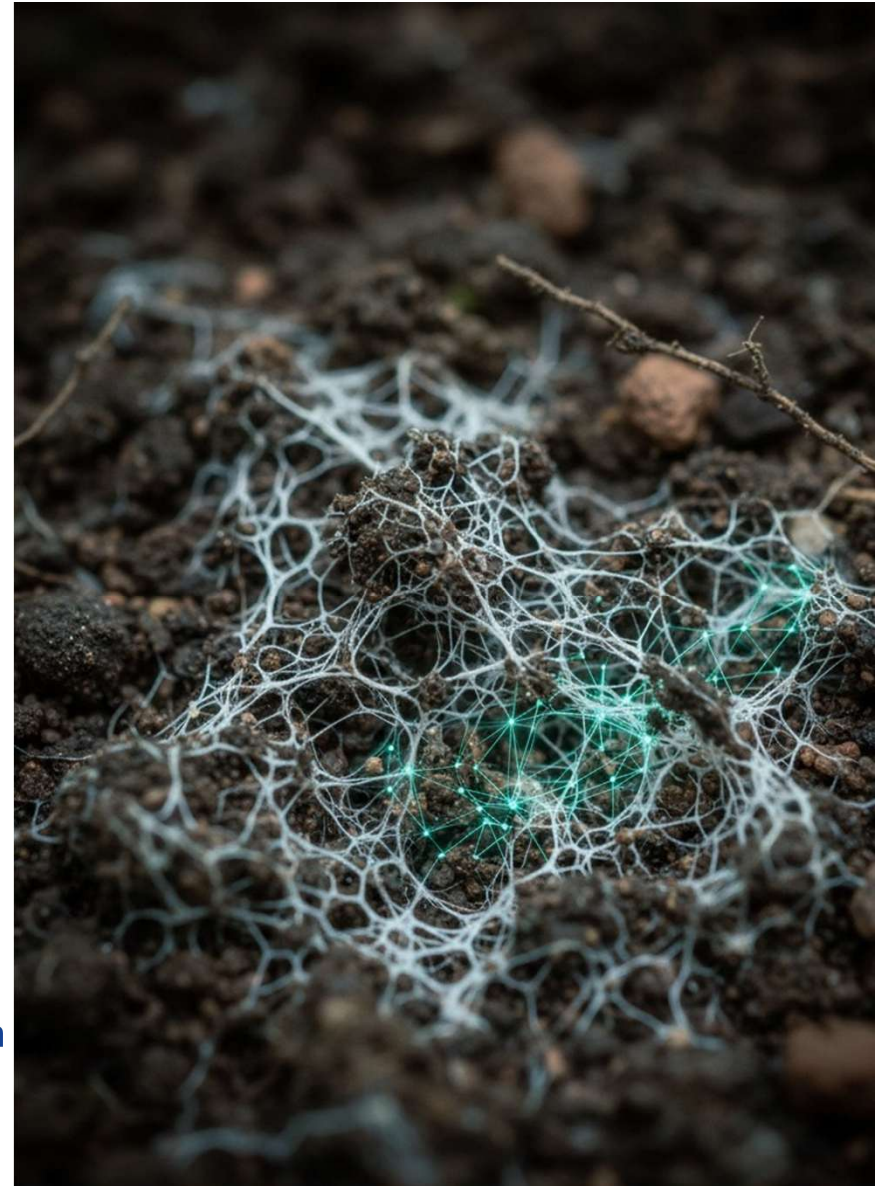
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LIFE PFASTER (GA 101146900)



Co-funded by
the European Union



1 site, 11 partners, 8 remediation routes

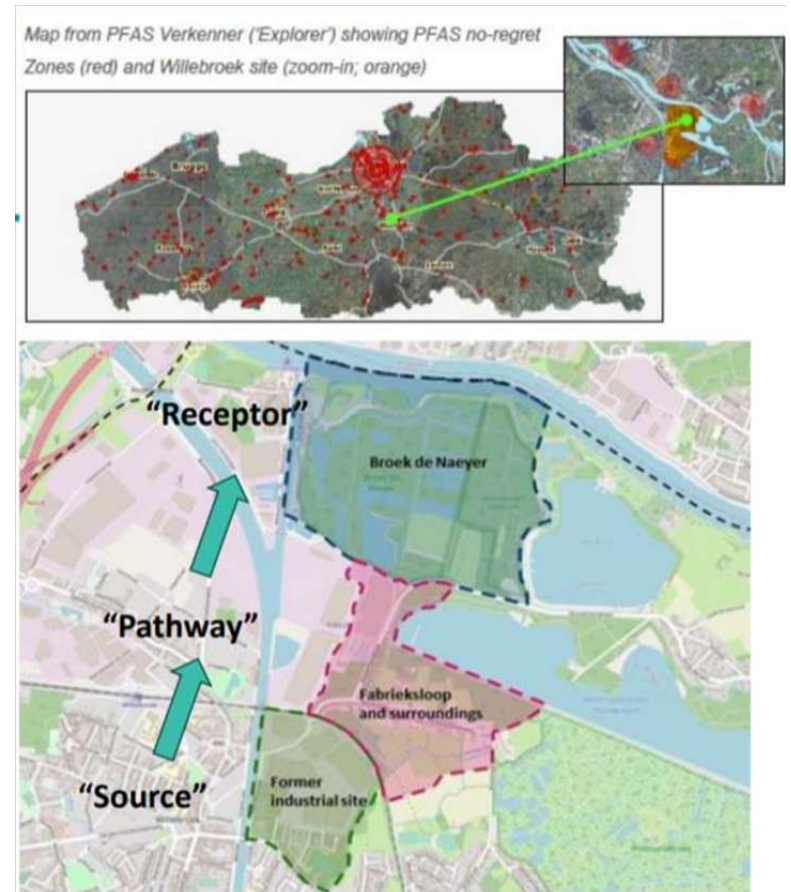
PFASTER maps how PFAS spread, transfer and reach people and ecosystems around the **former paper factory in Willebroek** and the **Broek De Naeyer nature area**, to build replicable approaches for diffuse PFAS in soil, groundwater, sediment, surface water and biota across Flanders and Europe.

3 INNOVATIVE TECHNIQUES FOR PFAS CONTAMINATED GW

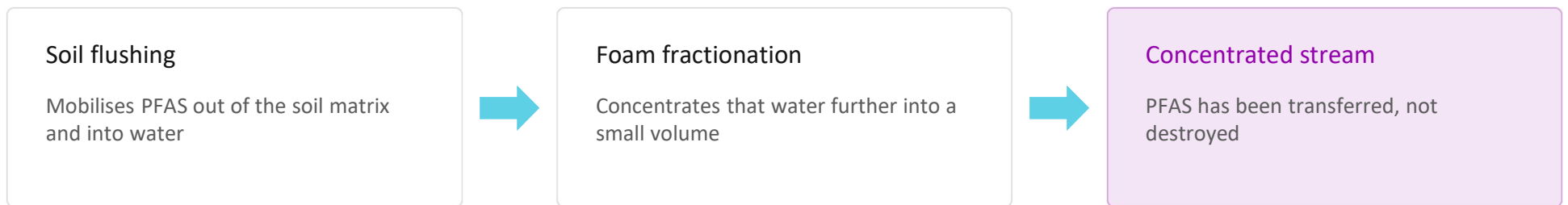
In-situ soil and groundwater flushing Jan De Nul
Membrane filtration and cold-plasma destruction VITO
Mycofiltration Novobiom · [this talk](#)

4 NATURE-BASED SOLUTIONS

Phytoremediation
Fungal bioremediation
Compost mycoremediation
Constructed wetlands & Floating wetlands



The bottleneck is the rinse stream



~350x

~35 µg/L of the 20 PFAS in the EU Drinking Water Directive sum, against its 0.10 µg/L benchmark.
All measured PFAS reach ~180 µg/L, mostly 6:2 FTS, which is not one of the 20.

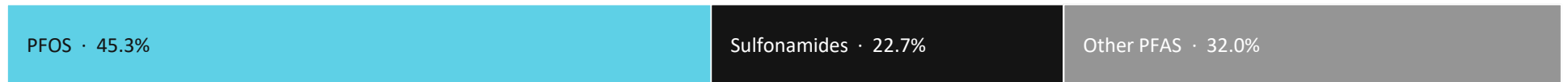
Too concentrated to polish, too voluminous to burn.

Every stream carries its own fingerprint

Our test stream · ~180 µg/L sum PFAS



Willebroek groundwater · 4.4× more dilute



Seven compounds found at Willebroek were not measured in the test stream; together they carry ~27% of the Willebroek PFAS mass.

6:2 FTS is a precursor, not a terminal acid. It changes what biology could plausibly do, and how any removal headline should be read.

Two lines of work, run in parallel

● LINE 1 · DISCOVERY

Seek functional PFAS-transforming strains from the site itself

- 1 On-site collection of indigenous fungi at Willebroek
- 2 PFAS tolerance and laccase screening
- 3 Flask tests of strains with biochar

Biological function under lab exploration: metabolic and enzymatic routes

● LINE 2 · TOWARDS PILOT SET-UP

Explore a mycofilter format with a model fungus

- 1 *T. versicolor* on biochar, beside a mineral granule
- 2 Three packed columns under the same hydraulics
- 3 PFAS removal, fungal viability, media sizing

Granule adsorbs best; fungal survival still to solve

1

● LINE 1 · DISCOVERY

Seeking functional PFAS-transforming strains

On-site collection, PFAS tolerance and enzyme screening, and flask tests. The biological function of these strains is still under lab exploration.

The site supplies the organism

79

fungus isolates recovered from decades-old contaminated soil and stabilised

11

carried into 14-day screening on minimal medium, with and without PFAS

The isolates grow with PFAS present. Tolerance is the precondition for everything downstream.

Species	Isolates
<i>Fusarium foetens</i>	WI815A, WI815B, WI816
<i>Galactomyces pseudocandidus</i>	WI856, WI859
<i>Apiotrichum sporotrichoides</i>	WI858
<i>Mucor moelleri</i>	WI861
<i>Mucor circinelloides</i>	WI862
<i>Trichoderma crassum</i>	WI863
<i>Metapochonia bulbillosa</i>	WI864

Laccase keeps running with PFAS present

ABTS plate assay at days 4, 7, 11 and 14, run in parallel with and without PFPeA

Consistent producers

WI858 *Apiotrichum sporotrichoides*: positive from day 4, peak at day 11

WI863 *Trichoderma crassum*: positive from day 4, peak at day 11, fastest grower

Late producers

WI815A and WI816: positive from day 11

One WI816 plate with PFAS did not express at all

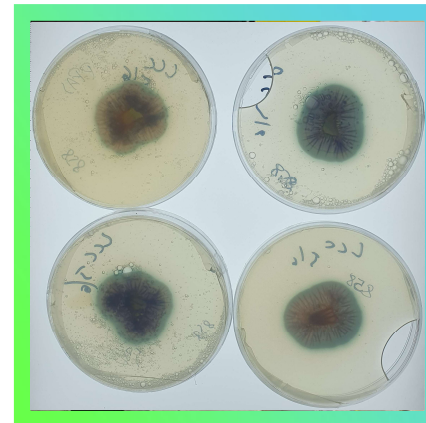
Effect of PFPeA

For nearly every strain, no change in growth rate or laccase expression

WI861 and WI862 varied in morphology, independently of PFAS

Laccase is a robustness marker, not a mechanism.

The metabolic and enzymatic routes by which the on-site strains could act on PFAS are still under exploration in the lab.



Flask tests: strains and biochar together



Batch flasks, March–May 2026 · PFAS-charged foamate, ~180 µg/L sum PFAS, 6:2 FTS ~78%

Biochar

Competitive PFAS adsorption capacity in batch

Strain U151 with biochar

Two short-chain PFAS increased over the run: the signal expected if precursors are transformed

A lead, not a result. Under exploration in the lab:

- Metabolic and enzymatic routes of the on-site strains
- Transformation products confirmed by LC-MS/MS
- A mass balance closed across water, carrier and biomass

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● LINE 2 · TOWARDS PILOT SET-UP

Exploring a mycofilter format with a model fungus

Carriers, column set-up, PFAS removal, fungal viability and media sizing: the questions a pilot has to answer first.

Sorption and biology on the same particle

***Trametes versicolor* TS12-2 on biochar**

Model fungus; full colonisation in 10 days from a 2.5% inoculum

Carrier matrix

90% biochar, 10% wheat bran (dry weight); pH 7.44; moisture ~46%

Composite granule

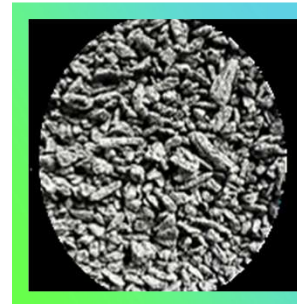
In-house mineral polisher, aimed at long and short chains

Plain biochar

Non-colonised control: the adsorption baseline



T. versicolor-colonised biochar



Composite mineral granule



Plain biochar

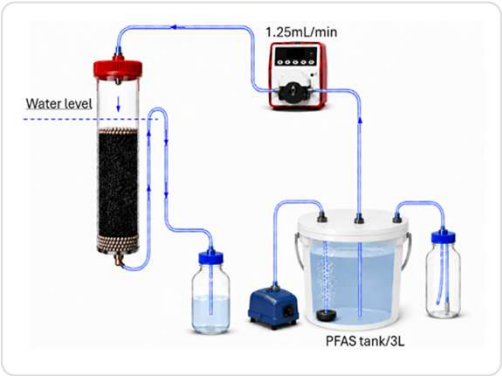
Design hypothesis

Put adsorption and biology on one particle: the sorbent captures PFAS and becomes the scaffold for an organism that may act on what it holds.

Three packed columns, one set of hydraulics



Single pass



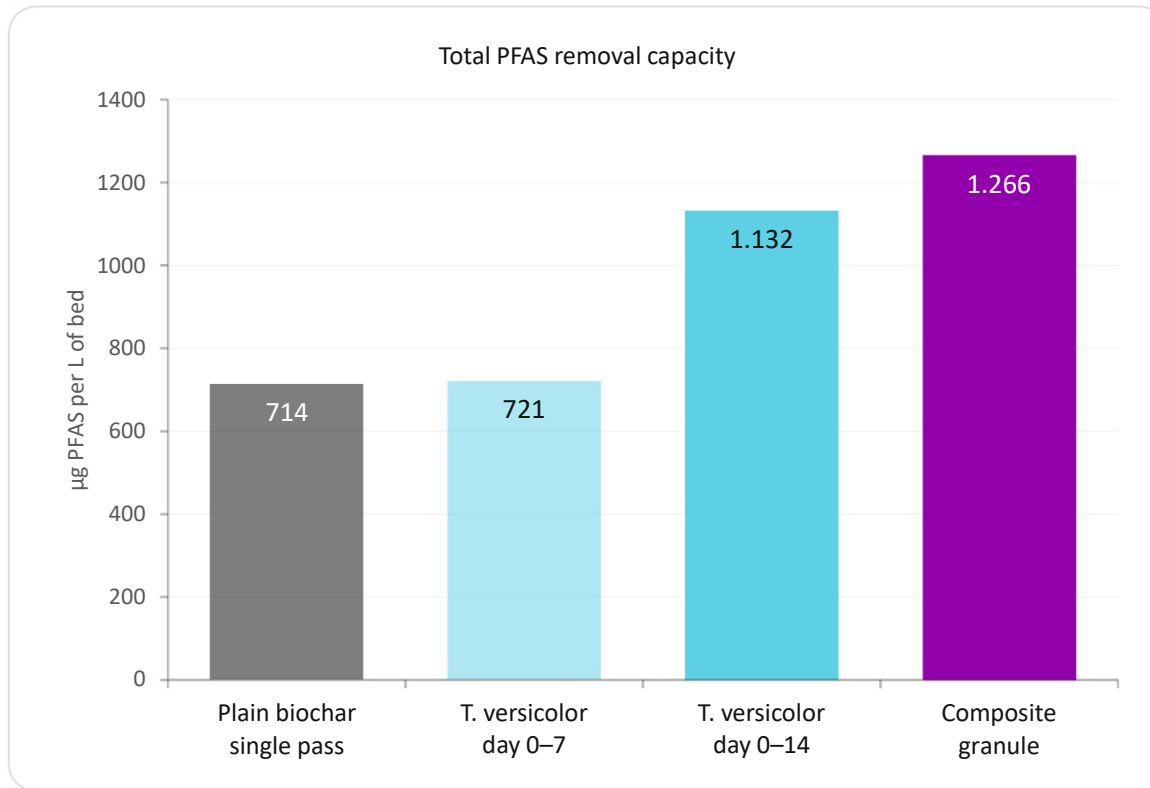
Recirculation

Medium	Mode	Run
Plain biochar	Single pass	128 h
<i>T. versicolor</i> / biochar	Recirculation	7 and 14 days
Composite granule	Recirculation	8 days

300 mL	1.25 mL/min	~4 h	27–30 °C	8.5	8.8 mg/L
packed bed	flow rate	retention time	temperature	pH, measured	dissolved oxygen

Monitored: PFAS in feed and effluent for every column; fungal viability by re-plating in the colonised column

Granule adsorbs most; fungal bed gains with time



≥1,266

µg PFAS per litre of granule bed, not yet saturated

721 → 1,132

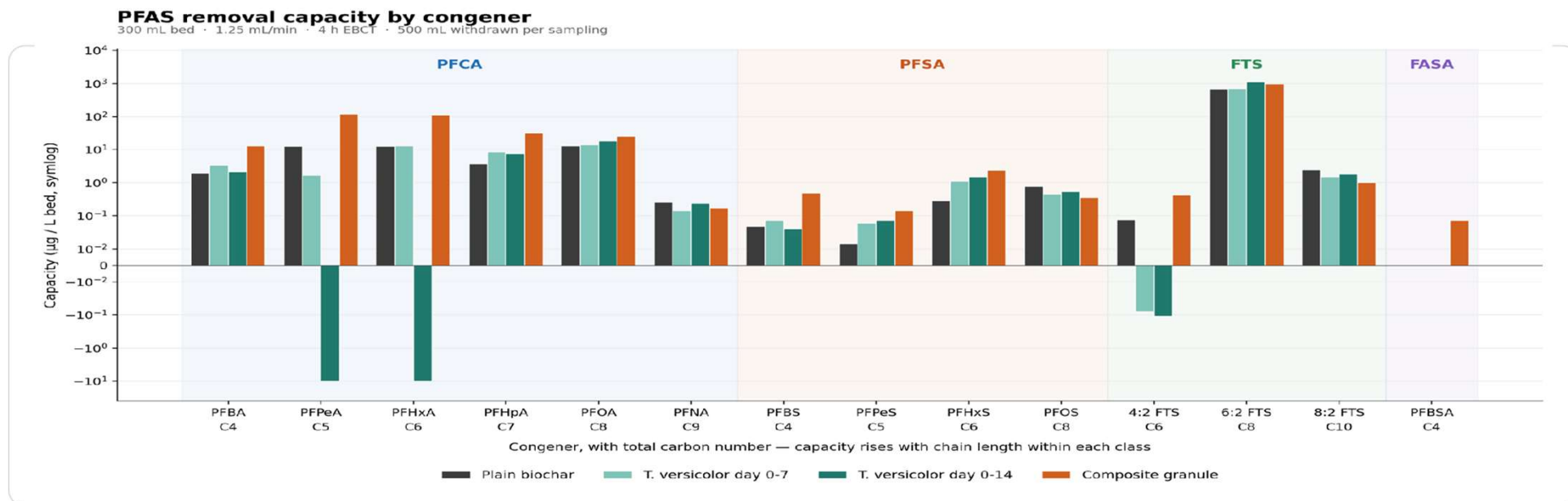
µg/L bed in the colonised column from day 7 to day 14, mostly 6:2 FTS

86–89%

granule capture of every congener except PFBA (66%)

Basis: 300 mL beds; test mixture 142 µg/L sum PFAS; only plain biochar reached breakthrough

Removal capacity by congener



Granule

Consistent removal of short and long chains; the bed is not saturated.

Competitive adsorption

From day 7 to 14, 6:2 FTS displaced PFPeA, PFHxA and 4:2 FTS in the colonised column.

6:2 FTS dominates

Share of retained mass: 93% plain biochar, 94% / 99% colonised (day 7 / 14), 76% granule.

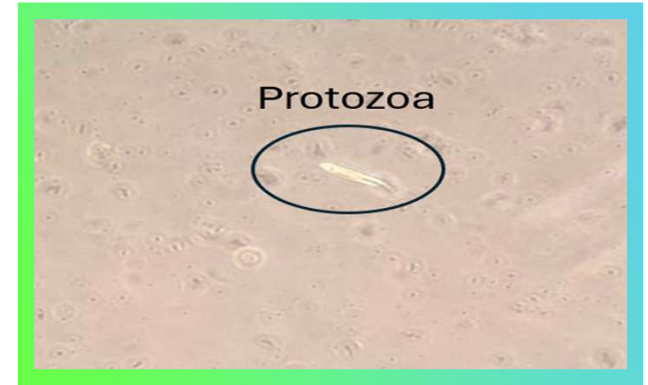
Submerged, *T. versicolor* did not survive



Start: healthy mycelium on re-plating



Day 7, PFAS feed: bacteria only, no culturable fungus



Day 13, in column: bacteria, ciliates, little mycelium

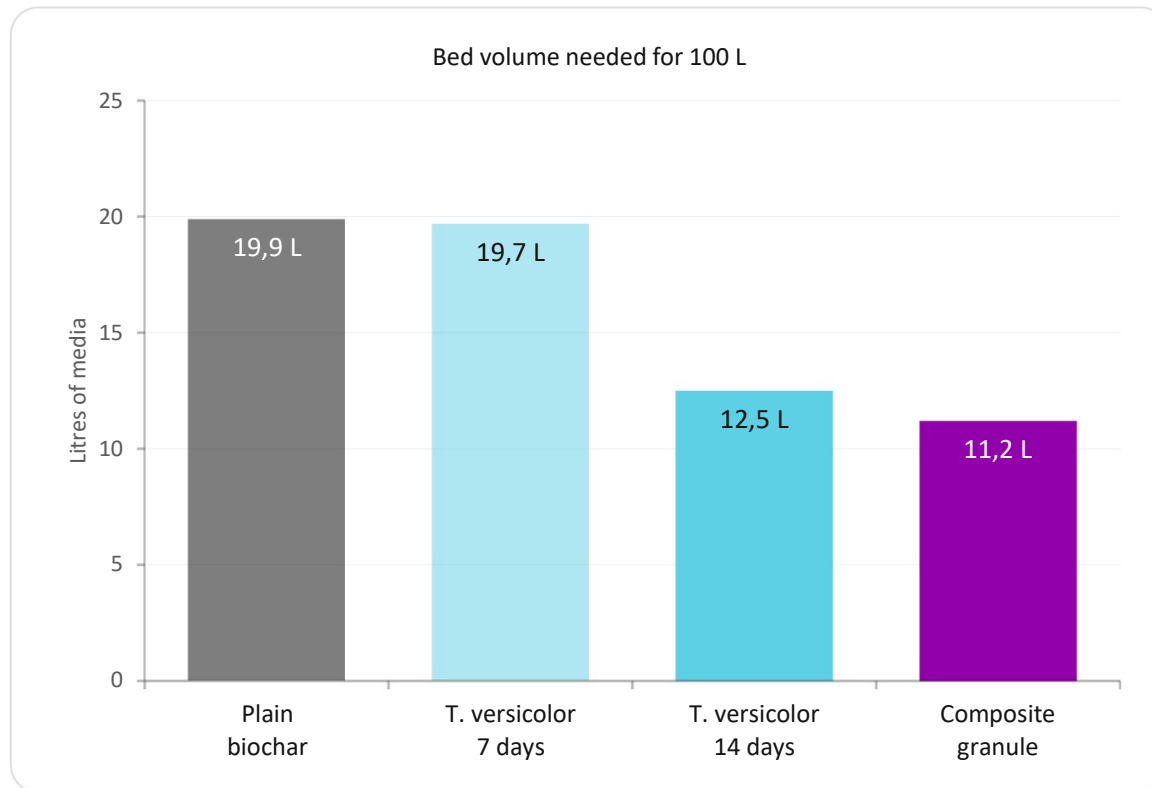
Probable cause: the operating mode

Bacteria appeared after one day on demineralised water, before PFAS. Oxygen supply, pH and food source are the suspects.

Next: change the mode, then measure

Unsaturated, trickling operation; stronger colonisation; an abiotic control to isolate the true fungal share.

Media required to treat 100 L of PFAS water



-44%

media with the granule than with plain biochar: 11.2 L vs 19.9 L

-37%

colonised biochar with 14 instead of 7 days of contact: 12.5 L vs 19.7 L

These ratios are the first sizing input for the pilot mycofilter.

What works, and what we solve before the pilot

WHAT WORKS

Composite granule: best removal of long- and short-chain PFAS; not yet saturated

Colonised biochar: capacity increases with longer contact time

Test rig: mini-columns and PFAS-safe set-up built, ready for the Willebroek mixture

WHAT WE ARE SOLVING

Granule stability

Binder breaks down after ~2 weeks, releasing fines

→ Binder reformulation

Fungal viability

Fungus lost within 7 days in submerged operation

→ Trickle operation, stronger colonisation, abiotic control

Short-chain PFAS

PFBA remains the limiting compound

→ Target for granule optimisation



Optimise media



Validate on the Willebroek mixture



Pilot set-up

In parallel, Line 1: metabolic and enzymatic routes of the on-site strains remain under lab exploration.

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WHAT WE ARE TESTING

A sorbent bed fills up. We are testing whether biology can **keep it working**.

Our ask

Other concentrated rinse and foam-fractionate streams to test against, especially PFOS- and PFOA-dominated ones.

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Fungi are nature's chemists and recyclers.
We unlock them for impact at scale.
Impact rooted in deep science and great execution.



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