PFAS Challenge – Edition

CHALLENGE 3

Gemeente Leeuwarden

CEN

PFAS Destruction.
From containment to a verifiable endpoint.

The water system surrounding Leeuwarden Air Base is affected by widespread PFAS contamination. PFAS have been detected in surface water, sediments, dredged material and vegetation removed from waterway banks. Continued leaching from contaminated soils into groundwater and surface water means that PFAS continue to enter the water system. From there, PFAS accumulate in sediments, vegetation and material streams generated during routine waterway management.

This is not a single contaminated site or an isolated batch of contaminated material. The challenge covers an area of approximately 1,100 hectares and around 80 kilometres of waterways. Restrictions are currently in place on activities including swimming, fishing and irrigation. In some locations, routine maintenance activities such as dredging and aquatic vegetation removal are also restricted or require specific measures because of the presence of PFAS.

Removing PFAS from the area will most likely require a combination of technologies. Water treatment can capture and concentrate PFAS from surface water and process water. Separate treatment steps are needed for dredged material and aquatic vegetation to remove PFAS from the material and, where possible, make the treated material suitable for reuse or further processing.
These treatment steps can produce cleaner water and more manageable materials, but they do not in themselves eliminate PFAS from the treatment chain.

Concentration is not destruction

Treating PFAS-containing water, dredged material and aquatic vegetation generates a range of concentrated PFAS residual streams, including:

- liquid concentrates;
- spent filters, activated carbon and ion exchange resins;
- sludge and fine mineral fractions;
- treated organic fractions;
- ash, flue-gas treatment residues and other residual products from thermal processes.



This challenge is looking for technologies that can demonstrably and irreversibly destroy PFAS. The destruction step is the necessary endpoint of the wider treatment train. Without a verifiable destruction route, upstream water and material treatment will ultimately remain dependent on storage, export or other containment measures. Solutions must go beyond transferring, diluting, immobilising or storing PFAS. The ultimate objective is to demonstrably and permanently remove PFAS from the treatment chain without simply transferring them into other output streams.

The challenge

How can PFAS-containing streams from the area surrounding Leeuwarden Air Base be irreversibly destroyed?

Call for solutions

The Municipality of Leeuwarden is choosing to take action now to address PFAS contamination, even though scientific, technical and regulatory questions remain. Knowledge of individual PFAS compounds, their behaviour and potential degradation products continues to evolve, but the urgency of the situation calls for concrete, evidence-based action now. The long-term ambition is to restore safe and responsible use of the water system and reduce the persistent restrictions and uncertainty faced by farmers, residents, recreational users and water managers.

Pilot opportunities and integrated solutions

The Municipality of Leeuwarden wants this Innovation Challenge to go beyond identifying promising ideas. Technologies with strong potential may be considered for a follow-up phase focused on further validation and testing under relevant conditions. Technologies may be assessed individually or, where relevant, integrated as component technologies with other steps in the treatment train. The Municipality is ultimately seeking an end-to-end treatment approach that may combine several technologies and meets the applicable regulatory requirements for the different output streams.

The **Centre of Expertise Water Technology** is the technical knowledge partner for this challenge and will remain involved throughout the programme. CEW can support applied research, pilot design, monitoring and validation. This creates an opportunity within the Municipality of Leeuwarden to develop and test innovative PFAS removal, concentration and treatment technologies under relevant conditions.

Disclaimer

This challenge is a non-binding invitation to submit ideas and does not constitute a public procurement procedure. Participation does not create any entitlement to an award, compensation or further collaboration. The Municipality of Leeuwarden reserves the right to amend, suspend or terminate the challenge. All intellectual property rights relating to submitted proposals remain with the submitting party unless otherwise agreed in a separate agreement.

Evaluation criteria

Strong proposals should meet as many of the following criteria as possible.

1. Fit with the selected PFAS residual stream

Applicants should clearly state which liquid or solid PFAS residual stream their technology is designed to treat. The technology should be technically suited to the characteristics of the selected stream. A technology does not need to be suitable for every PFAS-containing stream, but its intended application should be clearly and realistically defined.

2. Demonstrated and irreversible PFAS destruction

The technology should demonstrate actual and irreversible destruction of relevant PFAS compounds. Applicants should clearly specify which PFAS compounds are treated, what fraction is fully destroyed, what fraction may be transformed and how much PFAS remains after treatment. A reduction in PFAS concentration in the original stream is not, by itself, sufficient evidence of destruction. Dilution, transfer, immobilisation or conversion into shorter-chain PFAS does not qualify as final destruction. Applicants should substantiate PFAS destruction through a PFAS balance and, where possible, a fluorine balance showing the quantities entering the process and the forms in which they are recovered after treatment. Relevant intermediate and degradation products should be included, together with all output streams to air, water and solid residues. Applicants should also address measurement uncertainty, unaccounted-for fluorine and limitations of the analytical methods used. Performance on short-chain and highly mobile compounds, including TFA, is considered a significant advantage, but limited performance on these compounds should not rule out otherwise promising progress on other relevant PFAS.

3. Validated performance and a realistic scale-up pathway

The technology should be capable of treating a real or representative PFAS residual stream with a composition relevant to the streams generated in this area. Applicants should define the operating envelope of the technology, including relevant ranges of PFAS concentration, moisture content, organic loading, salinity and material composition, treatment capacity, any pretreatment requirements and the process conditions required for operation. Laboratory data may be used as supporting evidence, but performance demonstrated only under favourable or simplified conditions is not sufficient. The technology should be ready for validation through a relevant pilot. Applicants should clearly distinguish between what has already been demonstrated,

what is expected based on research or previous experience and what still needs to be validated during a pilot. The technology should also offer a credible pathway towards application at larger treatment volumes.

4. Efficient use of energy and consumables, with minimal secondary waste

Energy, water, chemicals and other consumables should be proportionate to the amount of PFAS demonstrably destroyed. Where available, applicants should report the energy demand of the technology under representative operating conditions and specify the scale on which the figures are based. Information on the carbon footprint should also be provided. Regeneration and reuse of consumables are considered important advantages.

5. Regulatory and permitting feasibility

Applicants should explain how the PFAS residual stream and all resulting final and residual streams can be stored, transported, treated and processed in accordance with the applicable Dutch environmental, waste, water, emissions and ZZS (Substances of Very High Concern) requirements.

The applicable requirements depend on the nature and intended destination of each output stream. For output streams consisting of water, the relevant requirements under the Water Framework Directive apply. Assessment is based on the sum of 25 PFAS compounds, including TFA (trifluoroacetic acid) and Capstone B (6-2 FTAB), with an applicable environmental quality standard of <4.4 ng/L, expressed as the sum of these 25 PFAS compounds in PFOA equivalents. For output streams consisting of dredged material or aquatic vegetation, PFAS assessment is based on the recommended analytical list of 30 PFAS analytes: 28 linear and 2 branched compounds. The solution should provide a credible pathway towards meeting the applicable application thresholds under the current Dutch PFAS Framework:

- <7 µg/kg dry matter for PFOA
- <3 µg/kg dry matter for other PFAS

Where no direct route is available within the existing regulatory framework, applicants should identify the permits, experimental provisions, site-specific regulatory arrangements or engagement with the competent authority that would be required.

6. Economic viability

Where available, applicants should provide indicative operating expenditure (OPEX) and capital expenditure (CAPEX) and clearly state the scale, treatment capacity and underlying assumptions on which these estimates are based. The technology should offer a credible pathway towards economically viable operation at larger volumes of PFAS-containing residual streams.

Ready to apply?

Before submitting your proposal, please also review the Application Guide to make sure you include the technical and operational information we need to assess your solution.

ChallengeBase

