Established in 1992, OPEC Systems is a solution-focused remediation and contracting company. We specialise in the clean-up of complex contaminated sites throughout Australia.

For the past three years our scientists have worked collaboratively with our clients to develop and patent a mechanical, efficient and cost effective ‘downhole’ solution for removing per- and poly-fluoroalkyl substances (PFAS) from groundwater.

PFAS refers to a group of compounds used in a range of industrial applications. Many of these compounds are not amenable to environmental degradation and a growing body of research suggests they pose significant, long-term threats to human and environmental health.

The OPEC Downhole Foam Fractionation (DFF) system removes these potentially hazardous compounds, so that groundwater quality can be restored. It does so by foaming out priority PFAS compounds in-situ within specially designed groundwater wells, which can be strategically positioned within and on the boundaries of contaminated aquifers.

OPEC’s DFF system works by scavenging surface-active PFAS contaminants from solution within groundwater and collecting them in a recoverable foam medium at the top of the wells. A patented foam harvesting system is then used to concentrate, break and remove the PFAS-enriched concentrate from the wells and return it to a centralised control station, where it is further refined into a PFAS hyper-concentrate for offsite removal and destruction.

OPEC’s team of PFAS specialists is not just limiting its efforts to removal of PFAS from groundwater. Our team is also working on a suite of PFAS-related technologies applicable to waste transport and disposal solutions, PFAS extraction from soil and above ground sources of PFAS-contaminated water, and the capture of short chain PFAS compounds from the environment.

Our management systems are certified to the following international standards:
Proven Technology Delivering Outstanding Results

The OPEC DFF system was developed and refined by OPEC Research and Development Scientists at purpose-designed laboratories in Sydney and Melbourne.

The assessment of the lab and field trials was conducted by NATA-approved laboratories using extended PFAS methods. Results and findings were peer reviewed by renowned Australian and International PFAS remediation experts.

A robust QA/QC process, again conducted by NATA-accredited laboratories, was undertaken. The results reconfirmed that the OPEC DFF rapidly and comprehensively removes a broad array of PFAS compounds (including PFOS, PFOA, PFHxS and 6:2FTS) from groundwater, with no known adverse environmental impacts.

- Over 99% removal of PFOS and PFOA from groundwater within minutes of foam fractionation being initiated
- Testing results for 31 TOPA-PFAS Analytes
- Found to be effective on a minimum of 11 other PFAS compounds including PFHxS and 6:2FTS
Simple and Effective

1. Compressed air introduced to base of well
2. PFAS foams out of solution
3. Air bubbles carry foam to surface
4. Downhole extraction head harvests foam concentrate and delivers to control centre
5. PFAS Concentrate receives secondary and tertiary refinement
6. Hyper-concentrated PFAS solution is directed for destruction
7. Treated clean water is returned to aquifer or run through final polishing filter

Legend
- Compressed Air Delivery Lines
- Hyper-Concentrate Recovery Lines
- Clean Water Return Line
- OPEC DFF Well
- Contaminated Area
How the OPEC DFF Works: Air In, PFAS Out

Many of the priority PFAS compounds have a natural predisposition to foaming. The Aqueous Film Forming Foam (AFFF) used for decades by fire fighting agencies around the world provides a good example of this trait.

The OPEC DFF takes advantage of this characteristic by engineering an environment within the well to support rapid foam generation. Air is introduced to the base of the well through a diffuser, which is located in close proximity to an inlet screen. This allows the upward current produced by the rising bubble column to draw fresh groundwater into the well. The diffuser is selected to create a tailored spectrum of optimally sized bubbles, which rise up through the water column in the well. The dense bubble column and high surface area of the bubble interfaces produce agitation and present an irresistible attraction for PFAS in solution. They are quickly scavenged from the groundwater and drawn to the top of the water column. The foam formed at the top of the well is highly enriched in PFAS and by using a unique, purpose-designed extraction head, can be optimally crowded and drained.

Before the foam has a chance to collapse and dissolve back into the water, it is harvested by the OPEC DFF extraction head and drawn up to a centralised collection tank located within the control container on the surface. Assisted by gravity, the groundwater in the top of the well, now depleted in PFAS, is then allowed to drain through an upper well screen back into the surrounding aquifer. Due to the dynamic head created by the bubble column, it induces a radial circulation pattern back to the lower well screen. In this process, continual operation of an OPEC DFF well eventually flushes and removes PFAS from the subsurface to a radius of influence that is primarily dependent on three things. These are:

1. the hydraulic conductivity of the aquifer
2. the induced height of the water/foam interface above the static groundwater level
3. the rate of recharge of contaminated water from upgradient sources.

PFAS concentrate drawn to the surface is further refined in secondary and tertiary treatment tanks within the control container. These systems continue to extract and concentrate the contamination and separate it from the ground water component until only a PFAS hyper-concentrate remains for collection and offsite disposal. Clean residual waters are directed to a temporary holding tank and, only after further assessment and confirmation of compliance with regulatory guidelines, they are redirected back into the aquifer.
Many homes rely on drinking water partially or wholly sourced from bore water. DFF wells offer the ability to ensure PFAS is removed from drinking water before it reaches the tap.

Where PFAS impacts to groundwater have extended offsite, DFF wells can be installed to manage and reduce plume size.

Positioning DFF arrays around known PFAS hotspots will remove over 99% of PFAS compounds and prevent the spread of contamination.

DFF wells can be installed in arrays on impacted site boundaries to remove PFAS compounds before groundwater flows offsite.

The DFF process creates a PFAS hyper-concentrate which is removed from site for complete destruction.

By removing PFAS from groundwater supplies used for watering livestock and crops, DFF wells reduce the risks associated with bioaccumulative compounds.

The DFF system can be installed to intercept hydraulic flow paths that end as seeps in aquatic environments.
Advantages of the OPEC DFF

LOW LONG TERM OPERATING COSTS
Once installed, the OPEC DFF system requires minimal onsite supervision and maintenance. To ensure optimal performance, a trained technician conducts periodic infield inspections, with many checks able to be undertaken remotely utilising integrated telemetry controls built into the DFF’s intelligent monitoring system. With nominal labour input after installation and virtually no consumables, long term operating costs are extremely low compared to ‘pump and treat’ or ‘permeable barrier’ systems.

ZERO ENVIRONMENTAL HARM
Compressed air is the primary gas used to drive the OPEC DFF process, so no secondary contaminants are created and there is no harm to the environment. The relatively small amount of liquid drawn to the surface containing PFAS concentrate can be further treated to produce a hyper-concentrate. The clean residual water is polished to comply with guidelines that will allow its return to the aquifer.

MINIMAL CONSUMABLES OR WASTE PRODUCTS
The OPEC DFF system utilises the bubbles formed by compressed air, as well as the inherent surface-active characteristics of the priority PFAS compounds, to decontaminate groundwater with remarkable efficiency. It does not require significant quantities of costly or difficult-to-dispose-of consumables, such as Granular Activated Carbon, resins or other reactive permeable barriers.

The OPEC DFF process requires no ancillary chemical inputs and, depending on the specific site conditions, the only consumable may be a negligible volume of final polishing medium.

“We as an environmental scientist with over 30 years’ experience in contaminated site remediaition, I am excited and proud to see OPEC, a vibrant Australian company, contribute part of the solution to this major global environmental problem.”

– Peter Murphy – OPEC Systems Managing Director
Creating Intelligent Environmental Engineering Solutions

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