Tennessee, U.S.

Application

Purification of surface water with PFAS and other contaminants to drinking water standards with regulatory compliance and Zero Liquid Discharge (ZLD)

Background

The Tennessee River water possess the usual challenges of metals (Fe, Mn) and background organics such as TOC, DOC, NOM and THM & HAA precursors. The source water faces the additional challenge of PFAS contamination that changes in concentration and composition with seasonal and weather events to exceed regulatory standards.

Figure 1: Reservoir on the Tennessee River

The ***Cuf*** pilot effectively removed multiple contaminants, including PFAS, in a single operation. The system comes preconfigured for PFAS recovery facilitating future upgrade. By implementing a pump to precisely injecting, mixing, and holding Colloidal Activated Carbon, ***Cuf*** provides a reliable, low-cost, and flexible solution for PFAS treatment, in addition to standard water purification. The ***Cuf*** process requires no pre-treatment, achieves 100% water efficiency and Zero Liquid Discharge (ZLD), and is NSF/ANSI/CAN 61-372 certified.

On Site Verification Performance

Sustained PFAS removal using **CAC** on the more challenging surface water with elevated levels of background TOC/DOC/NOM was piloted on site.

Cuf Activated Carbon Performance

The pilot was conducted using the equipment identified above taking water directly from a reservoir on the Tennesse river (no pretreatment) and background TOC of nominally 2.77 to 3.67 ppm to produce filtrate water quality.

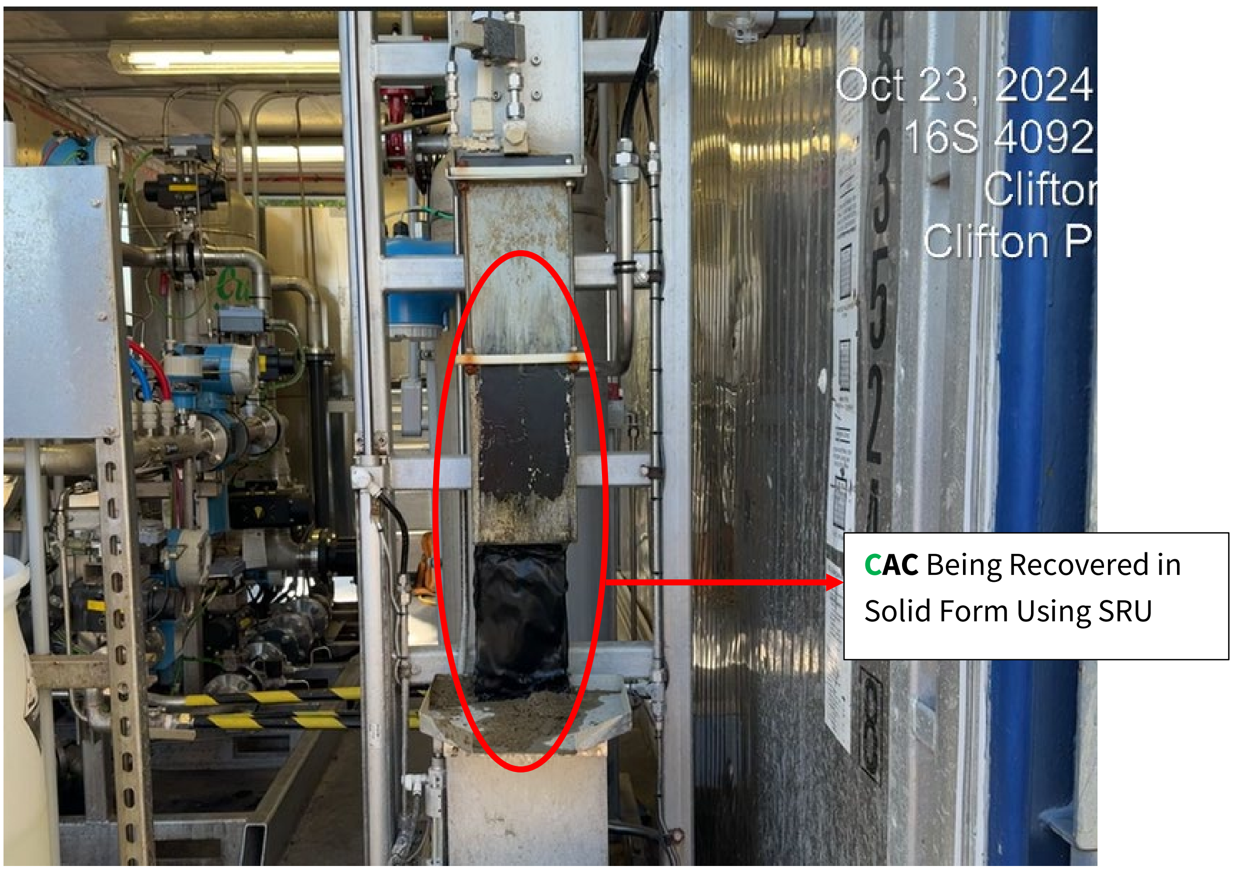
Parameter	Units	Raw Water	Existing Plant	CUF	CUF + CAC
TOC	ppm	2.77 - 3.67	2.24	1.38	< 0.72
TTHM	ppb	NA	90.7	33.3	1.3
HAA	ppb	NA	47	26	1
Geosmin	ppt	2.77	2.82	2.82	< 0.38
PFOS	ppt	14	NM	NM	< 1.8
PFOA	ppt	8	NM	NM	< 1.8
PFBA	ppt	12	NM	NM	< 1.8
PFPeA	ppt	2.2	NM	NM	< 1.8
PFBS	ppt	4.7	NM	NM	< 1.8
PFHxS	ppt	1.9	NM	NM	< 1.8
PFHpA	ppt	2.2	NM	NM	< 1.8
PFHxA	ppt	3.2	NM	NM	< 1.8
Total	**ppt**	**48.2**			**ND**

TOC, THMs, HAAs and Geosmin were efficiently removed in addition to PFAS after the CAC injection.

The ***Cuf*** pilot process demonstrated;

- Sustained 100% water efficiency
- Zero Liquid Discharge
- TOC removal 3.67 ppm → <0.72 ppm
- THM & HAA prevention
- The **Elimination** of pretreatment, Backwash and CIP
- Purification of river water to drinking water standards, including PFAS, in a single platform and in a 4-minute process time.
- Continuously produced water at 7 day intervals between rinses.

The picture below shows recovered **CAC** solids being discharged from the process in real time. The picture shows the solids falling off the flat plate SiC membrane after a dynamic shockwave. **CAC** solids can are handled through POD (PFAS On-Site Destruction).

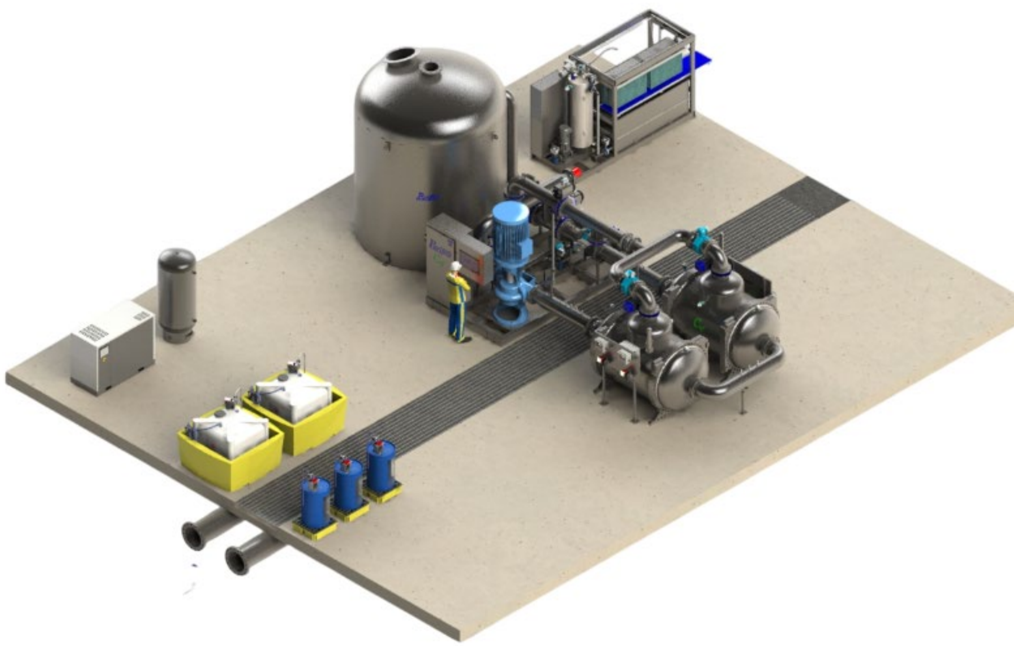


Performance Note

This is a high-performance achievement as surface water is much more challenging to process due to the high organic background that competes for the activated carbon. This challenge is not present in the easier purified ground water. The *Cuf* operation is consistent, sustained, durable and proven in municipal drinking water since 2014.

Cuf CAC Solution for PFAS

This solution, currently in full scale design, consists of the following.



This site has also evaluated GAC under an EPA funded pilot

GAC vs CAC cost evaluation to be available shortly.

Environmental & Economic Advantage

Estimated OPEX	$/1000 gal	$/m3
Energy Cost (0.64 kWh/kgal)	0.046	0.012
Coagulant 15 ppm	0.023	0.006
CAC 2 ppm	0.023	0.006
TMP Rinse Cost 0.5 Per Week	0.003	0.0007
Miscellaneous / Contingency/Maintenance	0.005	0.0013
O&M Cost Estimate	**0.100**	**0.026**

Cost and Consumption @ 2.0 MGD	Cost	Gal / MGD	L / MLD
Energy Cost (Industrial Average $/kWh)	$0.071		
Coagulant ACH (50%)	$1.04 / gal	22.2	84.18
CAC (35%)	$5.00 / gal	4.7	17.74
Sodium Hypochlorite (12.5%)	$1.46 / gal	0.1	0.45
Sodium Hydroxide (50%)	$2.30 / gal	0.0	0.16
Citric Acid (50%)	$4.47 / gal	0.03	0.10

Producing Better Water At Lower Cost

CapEx Reduction 80%

Footprint Reduction 75%

Chemical Reduction 80%

Energy Reduction 50%

OpEx Reduction 50%

Reference Documents

- On-Site Pilot Verification Program.
- Pilot Report
- Why ***Cuf*** for PFAS Removal.
- ***Cuf*** Process.

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