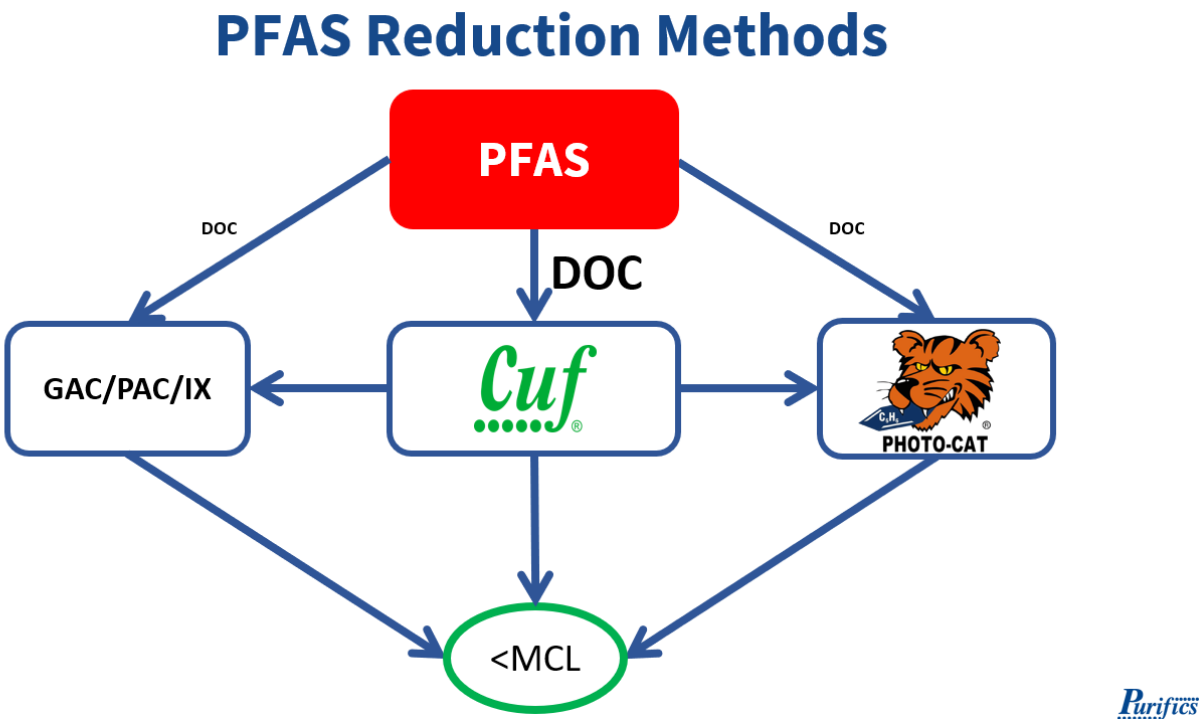
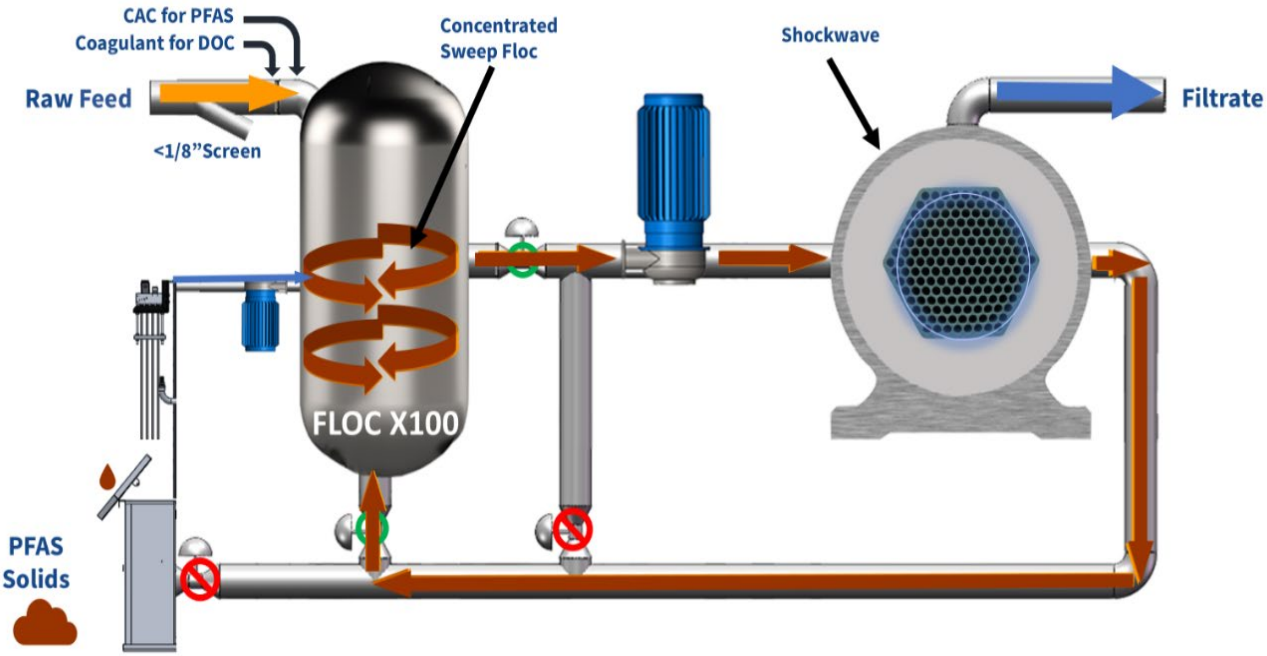
Better Water at Lower Cost

Since 1993 Purifics has been active in the recovery and destruction of water born contaminants. In 2005 Purifics became involved in the recovery and destruction of **"Forever Chemicals"** which today is generally characterized as **PFAS**. Purifics R&D and Applications Engineering Experience has achieved methods to recover (*Cuf*) and/or destroy (*Photo-Cat*) PFAS in ground and surface water with all its accociated background challenges



***Cuf* Activated Carbon (CAC)** is a high efficiency process that removes PFAS contaminants from surface and/or groundwater. It is a *Cuf* capability that can be activated at any time, in addition to *Cuf*'s primary scope of removing Metals, Bacteria, DOC, THM & HAA Precursors, color, taste and odor from water.

The *Cuf* process, has the ability, to precisely inject, mix, hold and recover **Colloidal Activated Carbon**, in a consistent and sustainable process, creating a reliable low-cost PFAS recovery solution for water purification. The *Cuf* process with **CAC eliminates** pre-treatment, back wash, tankage and bed maintenance. *Cuf*, a fully automated process, is 100% water efficient, Zero Liquid Discharge (ZLD) and NSF/ANSI/CAN 61-372 certified.



Cuf Activated Carbon Process

Solids Recovery & Disposal

CAC solids are disposed of and/or recovered in the same manner as GAC, PAC, or IX. The *Cuf* process has a proprietary and proven ability to De-Water and Recover (*DeWRS*) colloidal material as a solid in real time as demonstrated in the video capture to the right, with a proven 30-year track record across multiple industrial, remedial and municipal installations with regulatory compliance. **CAC** solids can be landfilled, thermally consumed or regenerated in the approved manor.

Proven Performance

Sustained PFAS removal using **CAC**, on the more challenging surface water which has elevated levels of background TOC/DOC/NOM, to levels below the MCL of 2ppt.

The CAC Difference Between GAC or PAC

GAC, PAC & **CAC** are all forms of Activated Carbon with each having successively smaller particle size and corresponding increased external surface area by mass that goes up **exponentially** from GAC -> PAC -> CAC. This **exponential** increase in **CAC** surface coupled with the high mass transfer of the *Cuf* process accelerates **exponentially** the rates

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of PFAS adsorption on to the CAC (Rapid Kinetics). In this **CAC** process, from the time the raw water is received, the PFAS is removed and discharged as a solid, is 4 minutes.

Activated Carbon	Nominal Diameter Ratio	Surface Area/Mass (m^2/g)	Surface Area Ratio
GAC	**3,000**	**0.0083**	**1**
PAC	**100**	**0.218**	**12,000**
CAC	**1**	**24**	**8,000,000**

Why CAC Features & Benefits

The ***Cuf*** **Activated Carbon** (**CAC**) process provides multiple benefits over traditional Activated Carbon Processes which includes:

1. The high Reynolds number (Re) (turbulence) of the ***Cuf*** process provides robust and effective mixing at the ppt level.
2. The ***Cuf*** process has a proven 30-year history of processing colloidal particles in the $50m^2/gm$ range. (*It should be noted that other processes are challenged when processing colloidal particles of this size*).
3. The dwell time of the Activated Carbon is precisely controlled for optimal adsorption efficiency regardless of changing feed water composition, PFAS loading and variation in feed rate resulting in lower Activated Carbon cost over PAC & GAC.
4. **CAC** is supplied as a colloidal suspension which allows it to be pumped just like a coagulant or any other process chemical which eliminates the dust and associated health hazard of handling GAC or PAC
5. **CAC** eliminates the need to fluff the bed of conventional activated carbon processes to prevent channeling.
6. The high Re number of the CAC process coupled with the 4 orders of magnitude higher surface are provides **ultra high mass transfer** over other AC process to effectively scavenge **ppt** levels of contamination and easily, reliably and consistently achieve MCLs.
7. One system provides the overall solution with Full Remote Automation/ LT2 Compliance and NSF/ANSI/CAN 61-372
8. The Regulatory History of the ***Cuf*** process and **Activated Carbon** makes Regulatory Approval a known process.

PFAS

Per- and polyfluoroalkyl substances (PFAS) are a diverse group of chemical compounds that are resistant to heat, water and oil. For decades, these chemicals have been used in hundreds of industrial and consumer applications such as metal plating, fire-fighting foams, carpeting, apparels, upholstery, and food paper wrappings. The widespread use of PFAS compounds have led to its appearance in many ground and surface waters.

Cuf® Activated Carbon for PFAS Removal

Purifics' *Cuf*® (Continuous Ultra-Filtration) process is a disruptive game changer that challenges conventional process engineering, cost structures and performance criteria. *Cuf*® does much more than just filter – it is the ideal solution for PFAS removal and recovery for municipal, remedial and industrial applications. *Cuf*® removes contaminants of concern from water and fluid applications and concentrates them into low volume solid waste.

PPM concentrations of **Colloidal Active Carbon** are dosed into the *Cuf*® system, while a very small slipstream of concentrated PFAS laden **CAC** is discharged. The *Cuf*® process concentrates the **CAC** by orders of magnitude. The increase in **CAC** concentration, coupled with the turbulent mixing Ultra-Coagulation process in the *Cuf*®, generates greater removal efficiency of PFAS with increased loading efficiency onto the **CAC**. This reduces Activated Carbon costs and disposal requirements over Conventional Activated Carbon such as GAC and PAC.

Unlike carbon beds that have deteriorating performance between carbon changeout, the *Cuf*®'s 'feed and bleed' operation generates a steady state operation providing consistent removal rates and effective use of the adsorption capacity of the **CAC**. The *DeWRS*® (De-Watering Recovery System) concentrates the **CAC** into a low volume (up to 20%) solid waste (chemical & labor free), to provide a true ZLD (Zero Liquid Discharge) solution.

The *Cuf*®'s Continuous Ultra Filtration recovers 100% of the CAC material. Its' proprietary Dynamic Shock process self-cleans the *Cuf*® membrane in a continuous online operation. The shock is generated and travels through the water, the membrane and the module to drive the CAC off the membrane surface. This allows the process to operate with extremely high concentrations of **CAC** to increase removal efficiency.

A key advantage of the *Cuf*® process is the simultaneous removal of other contaminants of concern, eliminating the need for other unit operations (i.e. the *Cuf*® is the plant). Other contaminants of concern could be heavy metals, Color, DOC, Pathogens (>4 log), Radium, AS, Fluoride, Turbidity, Oil and Grease, H_2S, Phosphorous and THM & HAA Precursors. All of this is

performed in a single ***Cuf*** ® platform which eliminates conventional auxiliary pre and post treatments and their associated complexities and cost structures.

Reference Documents

- Case Histories
- On-Site Pilot Verification
- Pilot Repot
- ***Cuf*** ® process