

# Removal of PFAS from Drinking Water with Granular Activated Carbon



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# Who is Calgon Carbon?

## Corporate Profile

- World's largest producer of Granular Activated Carbon (GAC).
- Solves customer purification and separation problems with an array of technologies.
- Water treatment is core competency with a diverse product portfolio.

**\$619.8 million**

2017 net sales

**75 years**

experience

**1,400+ employees**



**25 offices**

sales and service

**20 facilities**

Manufacturing, reactivation,  
equipment

**240 patents**

# Removing PFAS for 15 Years

## Our Experience with PFAS Removal

- Bituminous, reagglomerated GAC is most effective for removing PFAS.
- We have installed over 45 large installations for PFAS removal in drinking water and remediation applications across the United States.
- We offer a complete solution including accelerated laboratory & pilot studies, activated carbon, equipment, on-site installation and exchange services, reactivation and financing.



Proven products and solutions for drinking water, wastewater, remediation and POET



Carbon reactivation to thermally destroy PFAS and enable the reuse of activated carbon



Unrivaled technical service



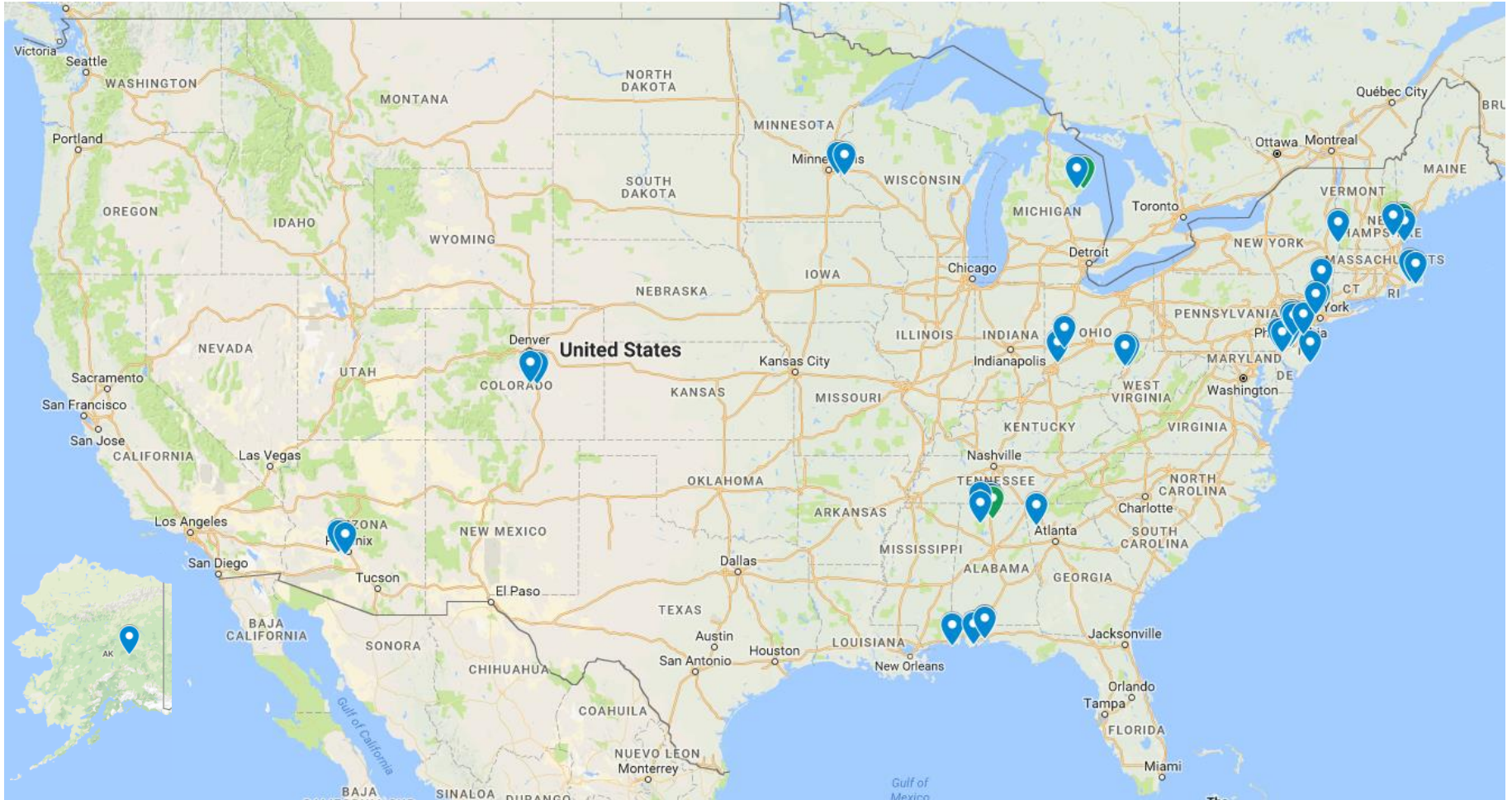
Laboratory & field testing for tailored solutions



Applications Engineers and R&D team dedicated to solving customer problems

# Calgon Carbon

## PFAS Treatment Locations



45+ Installations Across the U.S.

# Viable Technologies: Pros



## Advantages of Select Treatments

### Granular Activated Carbon (GAC)

**Most studied technology**

**Will remove 100% of the contaminants, for a time**

**Good capacity for some PFAS**

Will remove a significant number of disinfection byproduct precursors

Will help with maintaining disinfectant residuals

Will remove many co-contaminants

Likely positive impact on corrosion (lead, copper, iron)

### Anion Exchange Resin (PFAS selective)

**Will remove 100% of the contaminants, for a time**

**High capacity for some PFAS**

**Smaller beds compared to GAC**

Can remove select co-contaminants

### High Pressure Membranes

**High PFAS rejection**

Will remove many co-contaminants

Will remove a significant number of disinfection byproduct precursors

Will help with maintaining disinfectant residuals

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# Viable Technologies: Cons



## Issues to Consider

**EPA is evaluating these issues to document where and when they will be an issue**

### **Granular Activated Carbon (GAC)**

**GAC run time for short-chained PFAS (shorter run time)**  
**Potential overshoot of poor adsorbing PFAS if not designed correctly**  
**Reactivation/removal frequency**  
Disposal or reactivation of spent carbon

### **Anion Exchange Resin (PFAS selective)**

**Run time for select PFAS (shorter run time)**  
**Overshoot of poor adsorbing PFAS if not designed correctly**  
Unclear secondary benefits  
Disposal of resin

### **High Pressure Membranes**

**Capital and operations costs**  
Membrane fouling  
Corrosion control  
Lack of options for concentrate stream treatment or disposal

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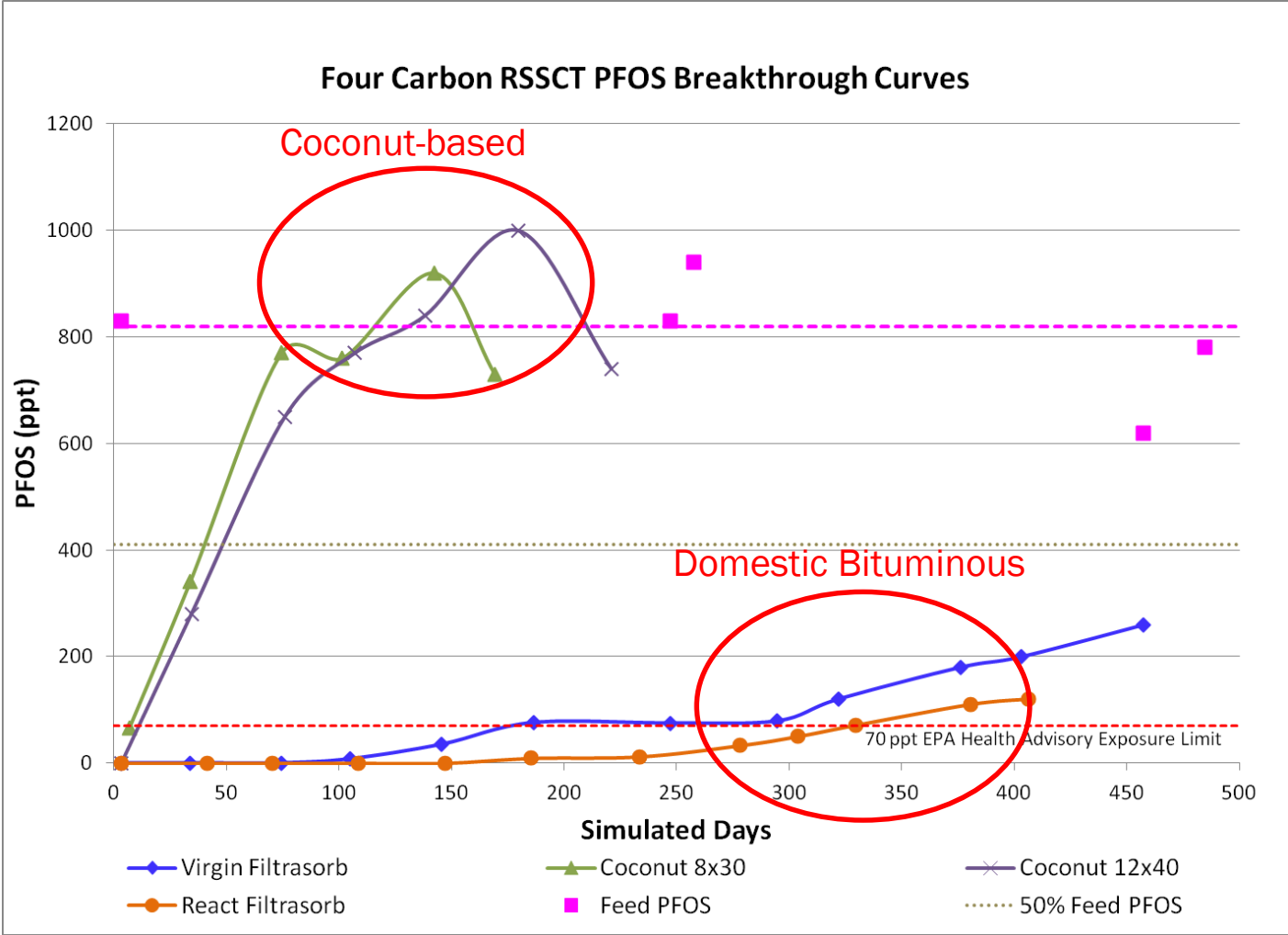
# Comparison of Various GAC for PFOA and PFOS Removal

Published in American Water Works Association Journal – January 2018

Goal: to determine what starting material provides best activated carbon for PFOA and PFOS removal.

Carbon Types	Source Material
Filtrisorb – Virgin	Domestic Bituminous Reagglomerated Coal
Coconut 8x30	Imported Direct-activated Coconut
Coconut 12x40	Imported Direct-activated Coconut
Filtrisorb – React	Reactivated Bituminous Reagglomerated Coal

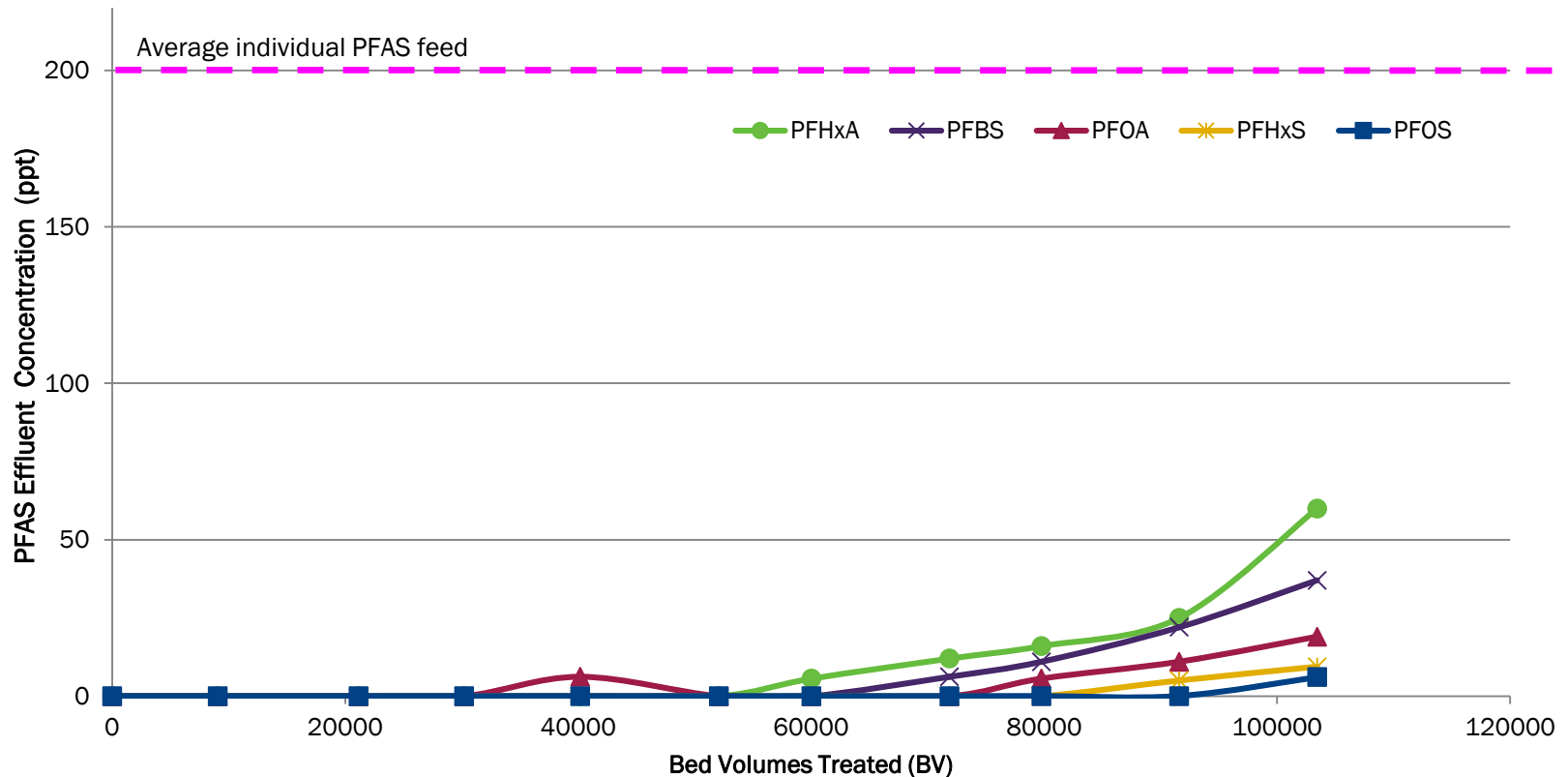
# Comparison of Various GAC for PFOA and PFOS Removal: Results





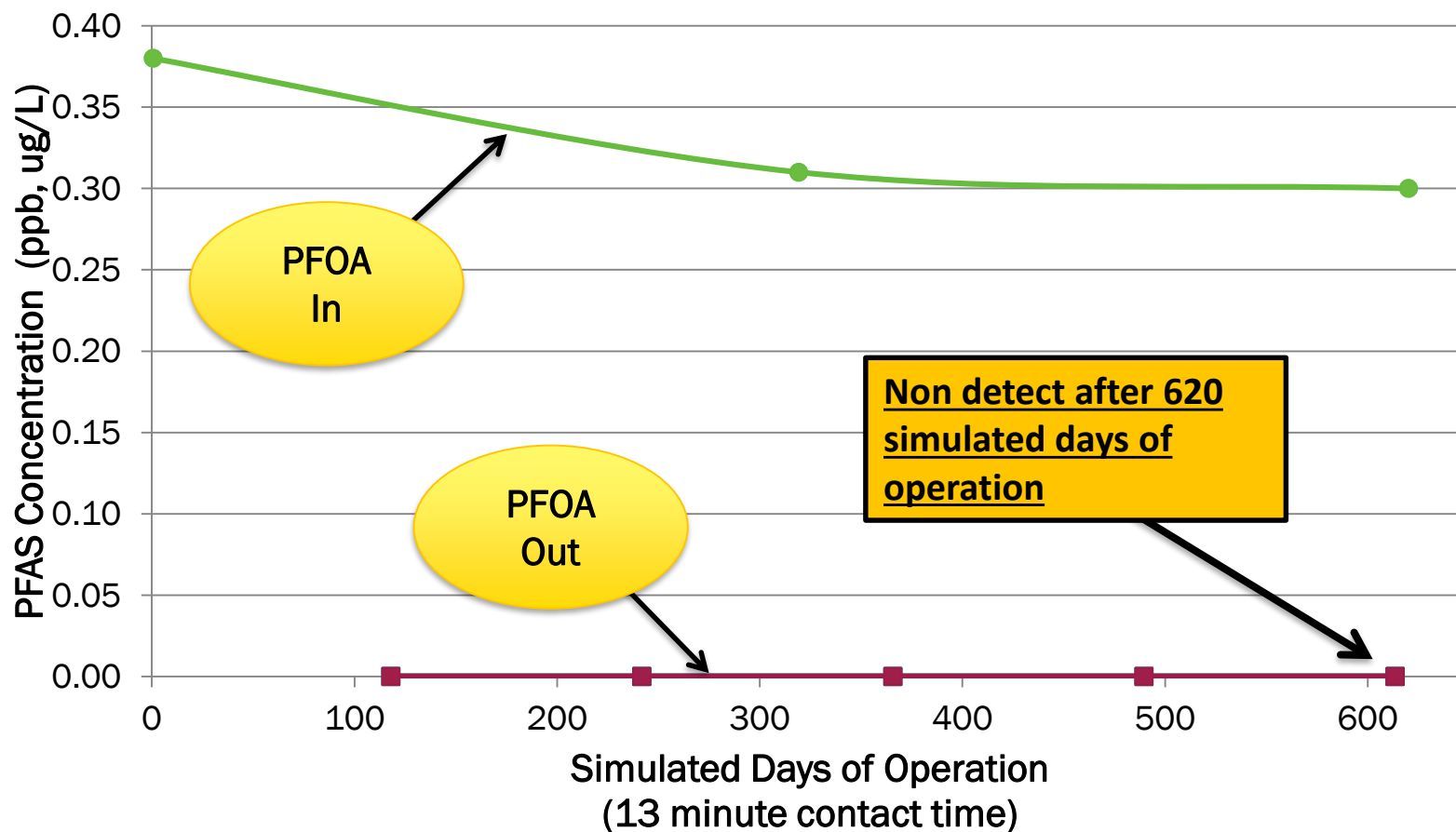
# Removal of multiple PFAS using Virgin Bituminous Reagglomerated GAC

Conclusion: GAC effectively removes more than just PFOA and PFOS, i.e. “short” chain compounds too.



# Is lab data predictive?

Lab-Scale Data: Simulated Days of Operation vs. PFOA breakthrough



# Customer's Field Data

Conclusion: Lab-scale testing sufficiently predicted full-scale results.

