CalgonCarbon
A Kuraray Company

Thermal destruction of PFAS during full-scale reactivation of PFAS-laden granular activated carbon

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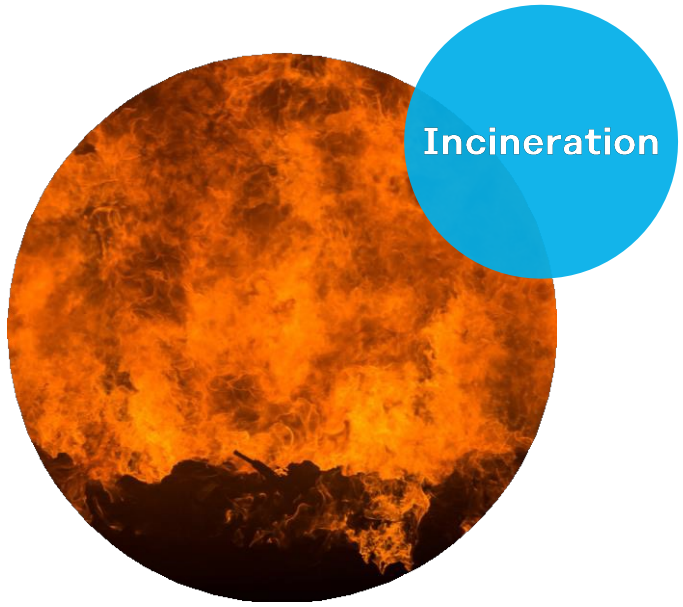
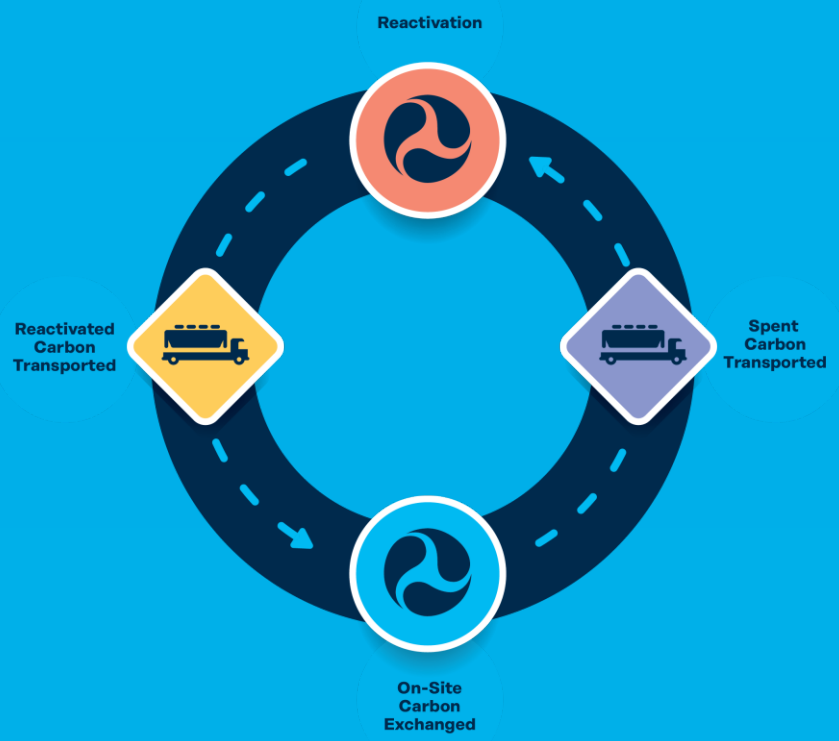
Drinking Water Solutions

Reactivation is a unique disposal & reuse option for GAC ONLY

Common methods used by many technologies (IX resin, Clay-based or novel sorbents) :



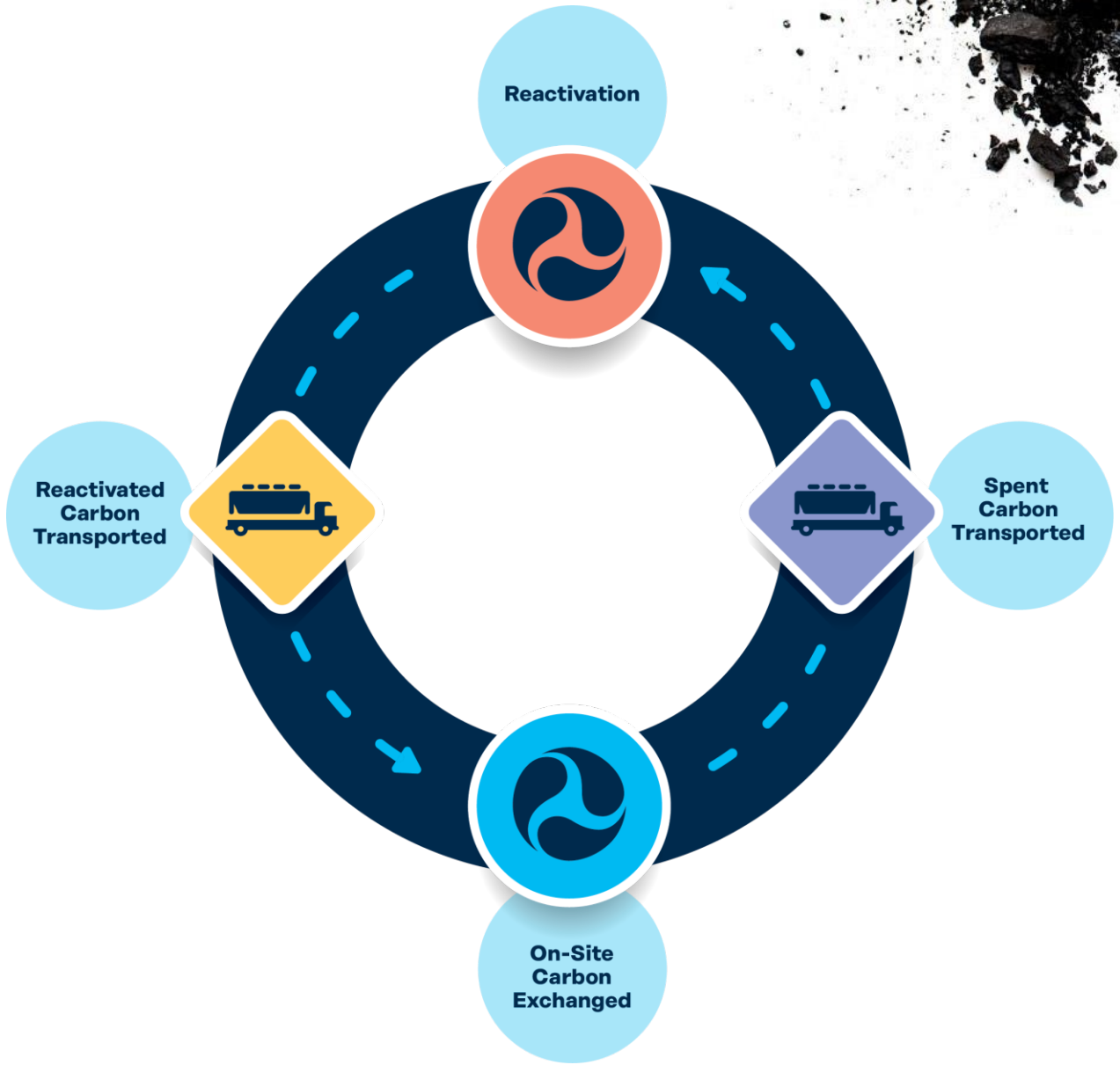
Unique to Activated Carbon:



Reactivation

How Our Products Help Customers and Society

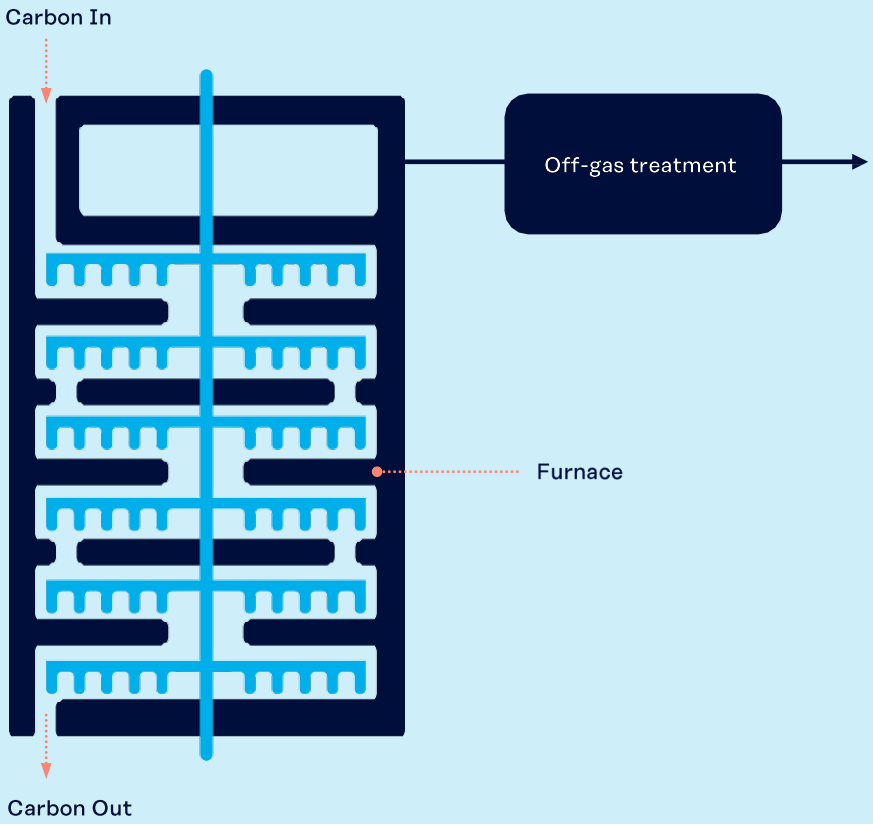
- Certified destruction of the adsorbed materials (which may be classified as hazardous (CERCLA or RCRA))
- No landfill liabilities and more sustainable solution
- 80% Reduction in CO_2 vs. the production of virgin carbon
- Lower cost than incineration and more sustainable



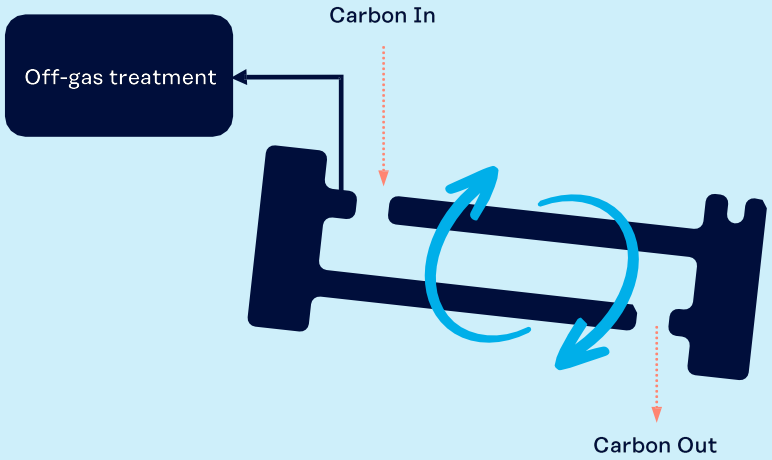
Reactivation Systems

There are two primary types of reactivation systems:

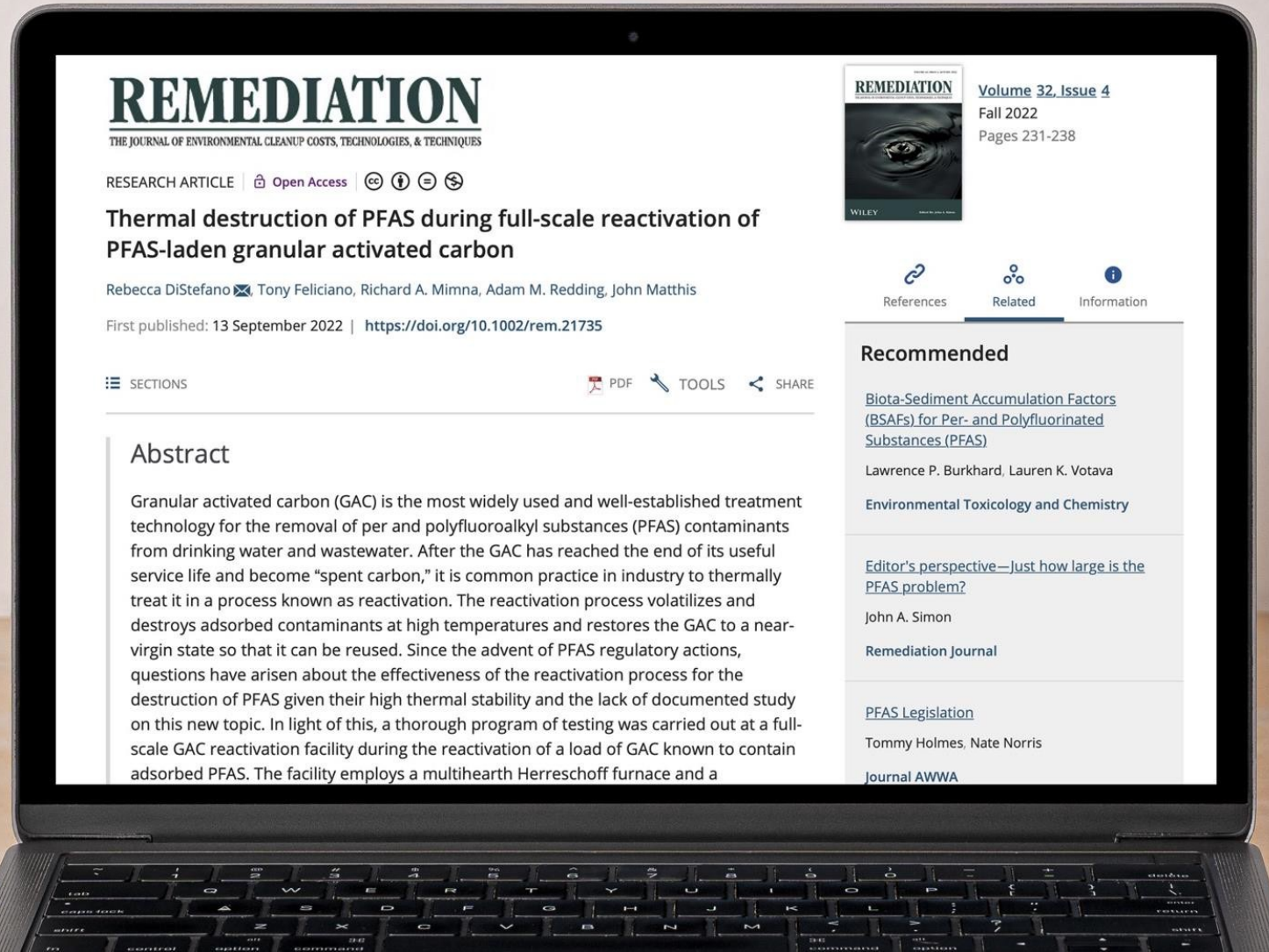
1 Multiple Hearth Furnace



2 Rotary Kiln



Recent Peer Reviewed Journal Article Demonstrating Calgon Carbon's Reactivation Effectiveness



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Calgon's Reactivation is a Unique Process with Multiple Destructive Technologies

1

High Temperature Reactivation Furnace

Remove adsorbed species & high levels of destruction

Spent Carbon

Reactivated Carbon

Solids Extraction (ELL/LC-MS/MS) for PFAS

Vapor Phase Analysis (OTM-45) PFAS

2

Thermal Treatment

Liquids Phase Analysis (EPA 537 1.1) PFAS

3

Chemical Scrubber

Remove acid gases, such as HF

Solids Extraction (ELL/LC-MS/MS) for PFAS

4

Baghouse

Remove particulate matter

Solids Extraction (ELL/LC-MS/MS) for PFAS

Vapor Phase Analysis (OTM-45) PFAS

5

Exhaust Stack

Best Commercially Available Analytical for PFAS was used

Calgon's Furnace & Abatement System Destroys PFAS

Hearth PFAS Destructive Reduction Efficiency (DRE): >99.9%

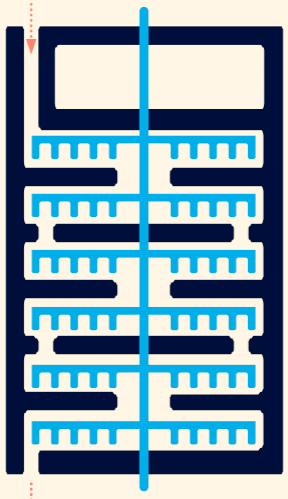
Complete System PFAS DRE: >99.99%

1

High Temperature Reactivation Furnace

Remove adsorbed species & high levels of destruction

Spent Carbon



Reactivated Carbon

Thermal Treatment

Further reduce species present from furnace offgas

3

Chemical Scrubber

Remove acid gases, such as HF

4

Baghouse

Remove particulate matter

5

Exhaust Stack

Robust, Additional Abatement Systems

Reactivation effectively removes PFAS below detection limits

NG/G		Spent Carbon Composite Sample for Each Emissions Test			Reactivated Carbon Composite Sample for Each Emissions Test		
		TEST 1	TEST 2	TEST 3	TEST 1	TEST 2	TEST 3
PERFLUOROBUTANOIC ACID	PFBA	6300	6700	4700	<1.9	<1.9	<1.9
PERFLUOROPENTANOIC ACID	PFPEA	2600	2500	1500	<0.58	<0.58	<0.58
PERFLUOROHEXANOIC ACID	PFHXA	3700	2900	1600	<0.58	<0.58	<0.58
PERFLUOROHEPTANOIC ACID	PFHPA	1600	1300	620	<0.58	<0.58	<0.58
PERFLUOROOCTANOIC ACID	PFOA	18000	14000	5800	<0.58	<0.58	<0.58
PERFLUORONONANOIC ACID	PFNA	88	72	53	<0.58	<0.58	<0.58
PERFLUORODECANOIC ACID	PFDA	71	51	21	<0.58	<0.58	<0.58
PERFLUOROUNDECANOIC ACID	PFUNDA	45	24	24	<0.58	<0.58	<0.58
PERFLUORODODECANOIC ACID	PFDODA	<9.7	<9.1	<9.6	<0.58	<0.58	<0.58
PERFLUOROTRIDECANOIC ACID	PFTRIDA	59	30	28	<0.58	<0.58	<0.58
PERFLUOROTETRADECANOIC ACID	PFTETDA	<9.7	<9.1	<9.6	<0.58	<0.58	<0.58
PERFLUOROBUTANESULFONIC ACID	PFBS	11000	8200	6300	<1.9	<1.9	<1.9
PERFLUOROPENTANESULFONIC ACID	PFPES	6700	4700	1200	<0.58	<0.58	<0.58
PERFLUOROHEXANESULFONIC ACID	PFHXS	33000	22000	5900	<0.58	<0.58	<0.58
PERFLUOROHEPTANESULFONIC ACID	PFHPS	5100	3100	810	<0.58	<0.58	<0.58
PERFLUOROOCTANESULFONIC ACID	PFOS	16000	12000	6700	<0.58	<0.58	<0.58
PERFLUORONONANESULFONIC ACID	PFNS	40	27	9.9	<0.58	<0.58	<0.58
PERFLUORODECANESULFONIC ACID	PFDS	180	110	37	<0.58	<0.58	<0.58
PERFLUORODODECANESULFONIC ACID	PFDOS	<32	<30	<32	<1.9	<1.9	<1.9
PERFLUOROOCTANESULFONAMIDE	PFOSA	340	340	380	<0.58	<0.58	<0.58
NMEFOSAA	NMEFOSA	720	550	560	<1.9	<1.9	<1.9
NETFOSAA	NETFOSAA	610	520	440	<1.9	<1.9	<1.9
HFPODA	GENX	6500	40000	55000	<1.9	<1.9	<1.9
4:2 FLUOROTELOMER SULFONIC ACID	4:2 FTS	<32	<30	<32	<1.9	<1.9	<1.9
6:2 FLUOROTELOMER SULFONIC ACID	6:2 FTS	290	110	800	<1.9	<1.9	<1.9
8:2 FLUOROTELOMER SULFONIC ACID	8:2 FTS	<48	<46	<48	<2.9	<2.9	<2.9
10:2 FTS	10:2 FTS	<32	<30	<32	<1.9	<1.9	<1.9
PERFLUOROHEXADECANOIC ACID		<9.7	<9.1	<9.6	<0.58	<0.58	<0.58
PERFLUOROOCTADECANOIC ACID		<9.7	<9.1	<9.6	2.2 / <0.57	<0.58	<0.58
SUM 29 PFAS COMPOUNDS:		112943	119234	92483	2.2	0	0

kuraray CalgonCarbon

High Loadings of PFAS on spent carbon!

PFAS below detection on reactivated carbon extraction

Conclusions & Key Findings

Calgon's Reactivation is a unique process that thermally removes PFAS and achieves high destruction in the reactivation furnace and our robust abatement systems

Reactivation is not the same as Regeneration (steam only)

Reactivation is less expensive than Incineration

Calgon Carbon's proprietary reactivation process and conditions achieved > 99.99% PFAS destruction for total PFAS

Reactivation is a safe, proven, simple, cost-effective and fully commercial offering

Reactivation is a sustainable process that has 80% reduction in CO_2