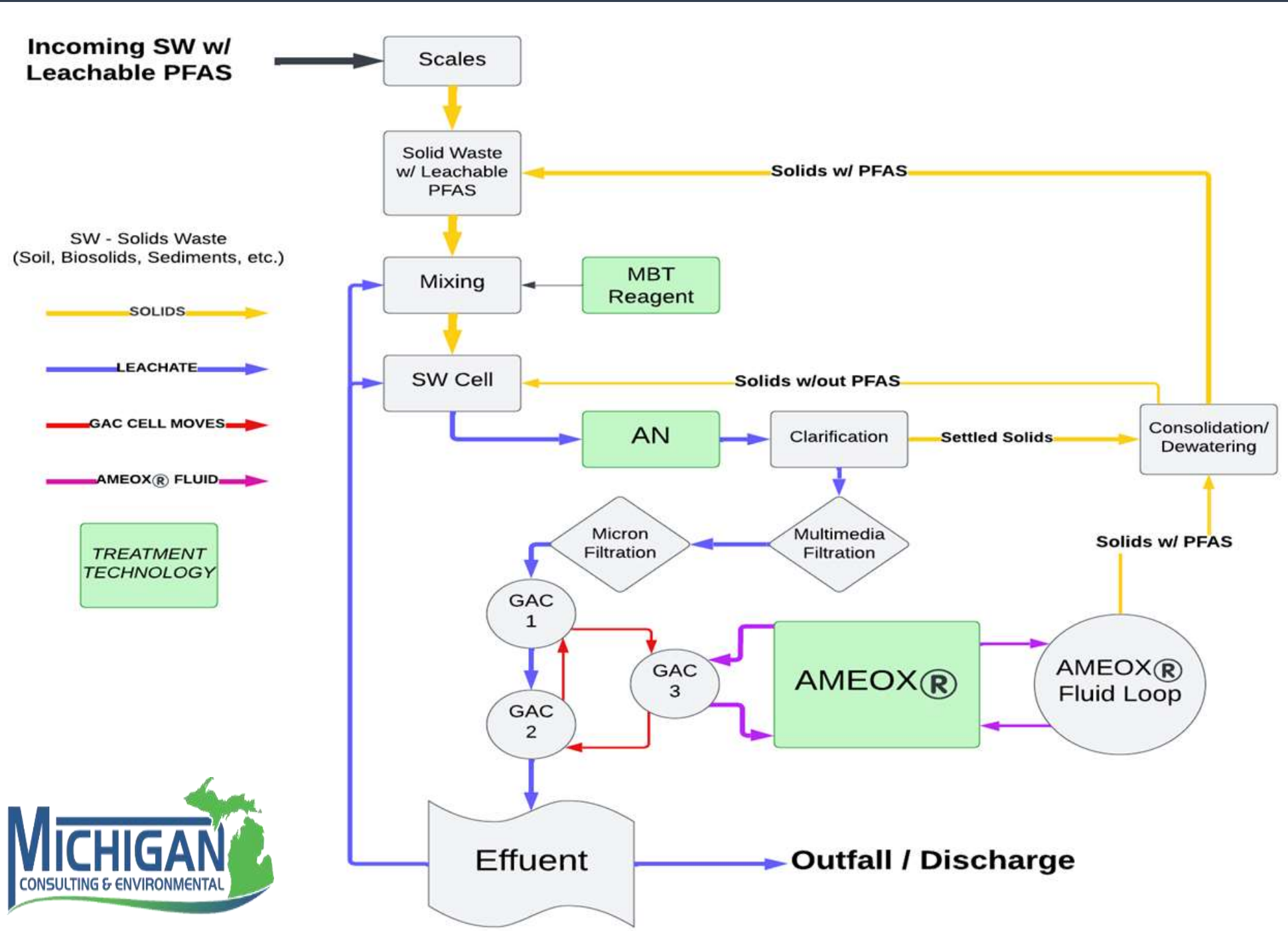
LANDFILL LEACHATE PFAS:

A MANAGEMENT SOLUTION

YB TECHNOLOGIES, LLC

LANDFILL LEACHATE PFAS MANAGEMENT SOLUTION©

Breaking the PFAS Cycle



YB TECHNOLOGIES, LLC

MICHIGAN CONSULTING & ENVIRONMENTAL

YB Technologies, LLC

Anacortes, WA

Treatment Technologies:

- MBT™ Treatment Technology:

  Leachable PFAS fixation/sequestration in soils/solid waste

- Advanced Neutralization™ (AN™):

  Leachate pretreatment to remove solids, destabilize, break emulsions, oxidize fluid

- AMEOX® Technology

  PFAS destruction in GAC for its continued use

Technologies are patented/patent(s)-pending in the US and abroad

Treatment Technology Pairing Benefits:

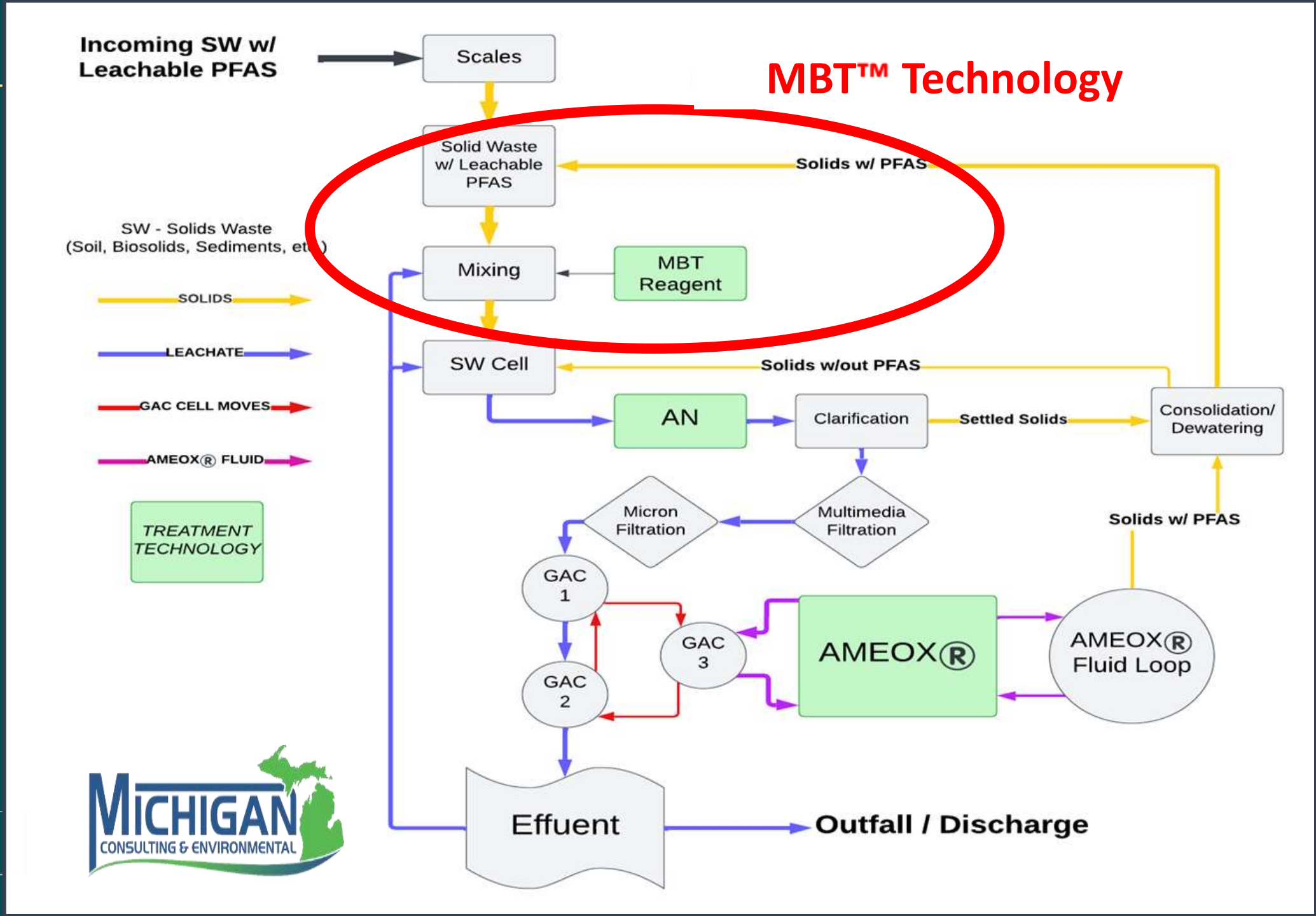
- PFAS-laden solid waste made suitable for Subtitle D landfill disposal
- Manufacture of Daily Cover Layering Product from raw material bearing PFAS for MSW sourced PFAS mitigation w/in cell
- PFAS removal from complex fluid (leachate) at low to moderate flow rate (20-200gpm)

PFAS Fixation/Sequestration in Soils/Solids by the MBT™ Technology

Striding to break the PFAS cycle…

LANDFILL LEACHATE PFAS MANAGEMENT SOLUTION©

Breaking the PFAS Cycle



YB TECHNOLOGIES, LLC

MBT PFAS Treatment: Applications

1) Soil & Sediments & Solid Waste
2) Biosolids – POTW / Landfill
3) Plating Related Solids
4) Spent Water Treatment System Residuals
5) Mine Waste Heap Leach/Froth Flotation

MBT Application Options
(In-situ or Ex-situ)

MBT™ Technology for Leachable PFAS Sequestration

- A blend of reagents mixed to soil/solid waste
- Yields soil-like mass that retains sequestered PFAS telomeres
- Removes PFAS from carrier fluids that contact treated material
    - landfill leachate
    - surface water run-off
    - groundwater that contact treated material
- Halts PFAS migration from treated material leachate/ground/surface waters

MBT Bench & Engineering-Scale Treatability Findings*

1. PFAS leachability reduction from host soil, sediments, other solid matrices

2. USEPA Test Methods to Leach PFAS from Solid Matrix:
   a) Method 1311 (TCLP – synthetic landfill leachate from lab grade reagents)
   b) Method 1312 (SPLP – acid rain from lab grade reagents)
   c) Modified Method 1312 (DI Water)
   d) Modified Method 1312 (Actual PFAS impacted groundwater)
   e) Modified Method 1312 (Actual Subtitle D landfill leachate containing PFAS)

* Analytical data and study summaries available upon request

MBT PFAS Leachability Viability Study Results (NOT optimized):

Western Michigan Site Soil – Method 1311 (TCLP)

Synthetic Landfill Leachate – lab grade reagents

PFAS Leachability: Method 1311 (TCLP)						
	UNTREATED Soil		MBT TREATED Soil			
	Totals in Soil (avg.)	Totals in TCLP Extract	T-1 Soil Extract	T-2 Soil Extract	T-3 Soil Extract	T-4 Soil Extract
Telomere	(ng/Kg)	(ng/L)	(ng/L)	(ng/L)	(ng/L)	(ng/L)
PFBA	264	50,000	49,000	50,000	<50	<50
PFOA	**536**	**4,400**	**1,800**	**1,000**	**<10**	**<10**
PFDA	1,175	<50	<50	<50	<50	<50
PFDoA	394	<50	<50	<50	<50	<50
PFTeA	1270	<50	<50	<50	<50	<50
PFOS	**29,600**	**1,700**	**1,500**	**630**	**<10**	**<10**
PFNS	346	<50	<50	<50	<50	<50
PFDS	765	<50	<50	<50	<10	<10
PFOSA	6265	<50	20	<50	<50	<50
EtFOSSA	4,055	62	<50	<50	<50	<50

MBT PFAS Leachability Viability Study Results (NOT optimized):

Western Michigan Site Soil – Modified Method 1312

(Actual Subtitle D Landfill Leachate Extraction Fluid)

PFAS Leachability: (Modified) Method 1312 with Subtitle D Landfill Leachate Extraction Fluid							
		UNTREATED Soil and Subtitle D Landfill Leachate			MBT TREATED Soil		
Telomere	Chemical Name	Totals in Soil (avg.) (ng/Kg)	Totals in Landfill Leachate (ng/L)	Totals in Soil Extract (ng/L)	T-2 Soil Extract (ng/L)	T-3 Soil Extract (ng/L)	T-4 Soil Extract (ng/L)
PFBA	Perfluorobutanoic Acid	264	1,900	1,800	1,500	1,500	1,300
PFOA	**Perfluorooctanoic Acid**	**536**	**680**	**490**	**200**	**170**	**110**
PFDA	Perfluorodecanoic Acid	1,175	230	57	<50	<50	<50
PFDoA	Perfluorododenoic Acid	394	<50	<50	<50	<50	<50
PFTeA	Perfluortetradecanoic Acid	1270	<50	28	<50	<50	<50
PFOS	**Perfluorooctanesulfonic Acid**	**29,600**	**450**	**<10**	**52**	**38**	**33**
PFNS	Perfluorononanesulfonic Acid	346	<50	<50	<50	<50	<50
PFDS	Perfluorodecanesulfonic Acid	765	<10	<10	<10	<10	<10
PFOSA	Perfluorooctanesulfonaminde	6265	<10	28	<10	<10	<10
EtFOSSA	N-Ethylperfluorooctrane	4,055	<10	<50	<50	<50	<50

MBT PFAS Leachability Viability Study Results (NOT optimized):

Western Michigan Site Soil – Modified Method 1312

(Actual Site Groundwater Extraction Fluid)

PFAS Leachability: (MODIFIED) Method 1312 (Site Groundwater Extraction Fluid)					
	UNTREATED Soil and Groundwater			MBT TREATED Soil	
Telomere	Totals in Soil (avg.) (ng/Kg)	Totals in Groundwater Extract (ng/L)	Totals in Soil Extract (ng/L)	T-2 Soil Extract (ng/L)	T-4 Soil Extract (ng/L)
PFBA	264	640	620	144	144
PFOA	**536**	**100,000**	**94,000**	**220**	**89**
PFNA	<0.26	86	70	<10	<10
PFDA	1,175	96	57	<50	<50
PFDoA	394	<50	<50	<50	<50
PFTeA	1270	<50	<50	<50	<50
PFOS	**29,600**	**390,000**	**190,000**	**230**	**121**
PFNS	346	<50	<50	<50	<50
PFDS	765	<10	<10	<10	<10
PFOSA	6,265	63	120	<10	<10
EtFOSSA	4,055	<50	140	<50	<50

MBT – PFAS Solid Waste Pilot

Confidential Site Source – Western MI

- Untreated Solid Waste
  - No characterization data available
  - PFAS indicated to be @ ~800,000 ng/Kg
  - MBT treatment regimes designed for 1,000,000 ng/Kg
  - **>15,000,000 ng/Kg actually confirmed!!**
  - ~150 lbs. treated (MBT-1 & MBT-2)
- Mortar Mixer
- MBT Reagents and Water for Mixing (Neutral pH/Pass Paint Filter Test)
- All treatments observed and sampled by Fishbeck
- Sample Duplicate Splits provided to YB
- Analyses by Fishbeck and YB

MBT – Pilot

Confidential Site Source, MI
MBT Processed Material

- Neutral pH
- No Free Liquids

MBT Treated Solid Waste in MIxer

MBT – Pilot

Confidential Site Source

Untreated Control

FTCH Lab = Trace/Fibertec

YB Lab = ALS Environmental

			UNTREATED: CONTROL			
			Yost Brothers (ALS)		FTCH (Fibertec/Trace)	
			TOTALS (dry wt)	TCLP	TOTALS (dry wt)	TCLP
PFAS Telomeres	Chemical Name	C Atoms	ng/Kg (dry-wt)	ng/L	ng/Kg (dry-wt)	ng/L
PFBA	Perfluorobutanoic Acid	C4	<150	<49	140	18
PFPeA	Perfluoropentanoic Acid	C5	170	<49	160	13
PFHxA	Perfluorohexanoic Acid	C6	350	<49	340	21
PFHpA	Perfluoroheptanoic Acid	C7	490	<49	430	20
PFOA	**Perfluorooctanoic Acid**	**C8**	**9,400**	**340**	**12,000**	**350**
PFNA	Perfluorononanoic Acid	C9	270	30	1,100	11
PFDA	Perfluorodecanoic Acid	C10	23,000	190	1,400	<10
PFUnA	Perfluoroundecanoic Acid	C11	2,200,000	3,800	2,800,000	<10
PFDoA	Perfluorododenoic Acid	C12	12,000	<49	<30	<10
PFTriA	Perfluorortridecanoic Acid	C13	990,000	130	1,200,000	<20
PFTeA	Perfluortetradecanoic Acid	C14	<150	<49	<120	<20
PFBS	Perfluorobutanesulfonic Acid	C4	79	<9.8	70	<10
PFPeS	Perfluoropentanesulfonic Acid	C5	1,109	<9.8	130	11
PFHxS	Perfluorohexanesulfonic Acid	C6	1,900	100	2,200	110
PFHpS	Perfluoroheptanesulfonic Acid	C7	7,500	210	8,900	160
PFOS	**Perfluorooctanesulfonic Acid**	**C8**	**6,800,000**	**80,000**	**10,000,000**	**32,000**
PFNS	Perfluorononanesulfonic Acid	C9	32,000	81	57,000	25
PFDS	Perfluorodecanesulfonic Acid	C10	45,000	23	61,000	<10
FtSA 4:2	Fluorotelomer Sulfonic Acid 4:2	C6	<150	<49	<30	<10
FtSA 6:2	Fluorotelomer Sulfonic Acid 6:2	C8	<150	<49	<30	<10
FtSA 8:2	Fluorotelomer Sulfonic Acid 8:2	C10	<150	<49	<30	<10
PFOSA	Perfluorooctanesulfonaminde	C8	140,000	160	180,000	39
N-EtFOSSA	N-Ethylperfluorooctranesulfonic amidoacetic Acid	C12	5,300,000	5,300	3,300,000	200
N-MeFOSAA	N-Methylperfluorooctranesulfonic amidoacetic Acid	C11	2,200	<49	2,900	<10
F-53BMin	11Cl-Pf3OUds	C10	<29	<9.8	NR	NR
ADONA	4,8-Doxa-3H-perfluorononanoic Acid	C8	<29	<9.8	NR	NR
F-53BMaj	9Cl-PF3ONS	C8	<29	<9.8	NR	NR
---	Hexafluoropropylene	C3	<150	<49	NR	NR
	Summation of PFOA :		**6,809,400**	**80,340**	**10,012,000**	**32,350**
	Summation of PFAS Telomere Totals:		15,565,468	90,364	17,627,770	32,978

MBT – Pilot (Treated TOTALS)

Confidential Site Source

MBT – Treatment #1

Treated: August 28, 2020

Analysis Date = End of MBT Treatment Reactions

			UNTREATED: CONTROL			Treated: MBT-1		
		Sample Date:	08282020-0900			08282020-1100		
		Laboratory:	ALS		Trace/Fibertec	ALS	Trace/Fibertec	ALS
		Analysis Date:	9/11/2020	10/5/2020	9/16/2020	9/9/2020	-	10/5/2020
			TOTALS	TOTALS	TOTALS	Totals	TOTALS	Totals
PFAS Telomeres	Chemical Name	C Atoms	ng/Kg (dry-wt)	ng/Kg (dry-wt)	ng/Kg (dry-wt)	ng/Kg (dry-wt)	ng/Kg (dry-wt)	ng/Kg (dry-wt)
PFBA	Perfluorobutanoic Acid	C4	ND	ND	140	<180	NA	<1400
PFPeA	Perfluoropentanoic Acid	C5	170	ND	160	<180	NA	<1400
PFHxA	Perfluorohexanoic Acid	C6	350	ND	340	<180	NA	<1400
PFHpA	Perfluoroheptanoic Acid	C7	490	ND	430	190	NA	<1400
PFOA	**Perfluorooctanoic Acid**	**C8**	**9,400**	**11,000**	**12,000**	**3,100**	**NA**	**1,800**
PFNA	Perfluorononanoic Acid	C9	270	670	1,100	130	NA	<1400
PFDA	Perfluorodecanoic Acid	C10	23,000	ND	1,400	12,000	NA	<1400
PFUnA	Perfluoroundecanoic Acid	C11	2,200,000	ND	2,800,000	1,600,000	NA	<1400
PFDoA	Perfluorododenoic Acid	C12	12,000	ND	ND	10,000	NA	<1400
PFTriA	Perfluorortridecanoic Acid	C13	990,000	ND	1,200,000	730,000	NA	<1400
PFBS	Perfluorobutanesulfonic Acid	C4	79	ND	70	<37	NA	<290
PFPeS	Perfluoropentanesulfonic Acid	C5	1,109	ND	130	<37	NA	<290
PFHxS	Perfluorohexanesulfonic Acid	C6	1,900	3,000	2,200	580	NA	<1400
PFHpS	Perfluoroheptanesulfonic Acid	C7	7,500	9,700	8,900	1,800	NA	<1400
PFOS	**Perfluorooctanesulfonic Acid**	**C8**	**6,800,000**	**8,900,000**	**10,000,000**	**2,400,000**	**NA**	**1,100,000**
PFNS	Perfluorononanesulfonic Acid	C9	32,000	45,000	57,000	25,000	NA	15,000
PFDS	Perfluorodecanesulfonic Acid	C10	45,000	68,000	61,000	40,000	NA	32,000
PFOSA	Perfluorooctanesulfonaminde	C8	140,000	180,000	180,000	120,000	NA	68,000
N-EtFOSSA	N-Ethyl perfluorooctane sulfonamido acetic acid	C12	5,300,000	8,300,000	3,300,000	3,500,000	NA	3,000,000
N-MeFOSAA	N-Methylperfluorooctane sulfonamidoacetic acid	C11	2,200	4,200	2,900	1,900	NA	2,200
	Summation of PFOA and PFOS:		**6,809,400**	**8,911,000**	**10,012,000**	**2,403,100**	**NA**	**1,101,800**
	Summation of PFAS Telomere Totals:		15,565,468	17,521,570	17,627,770	8,444,700	NA	4,219,000

MBT – Pilot (Treated TCLP)

Confidential Site Source

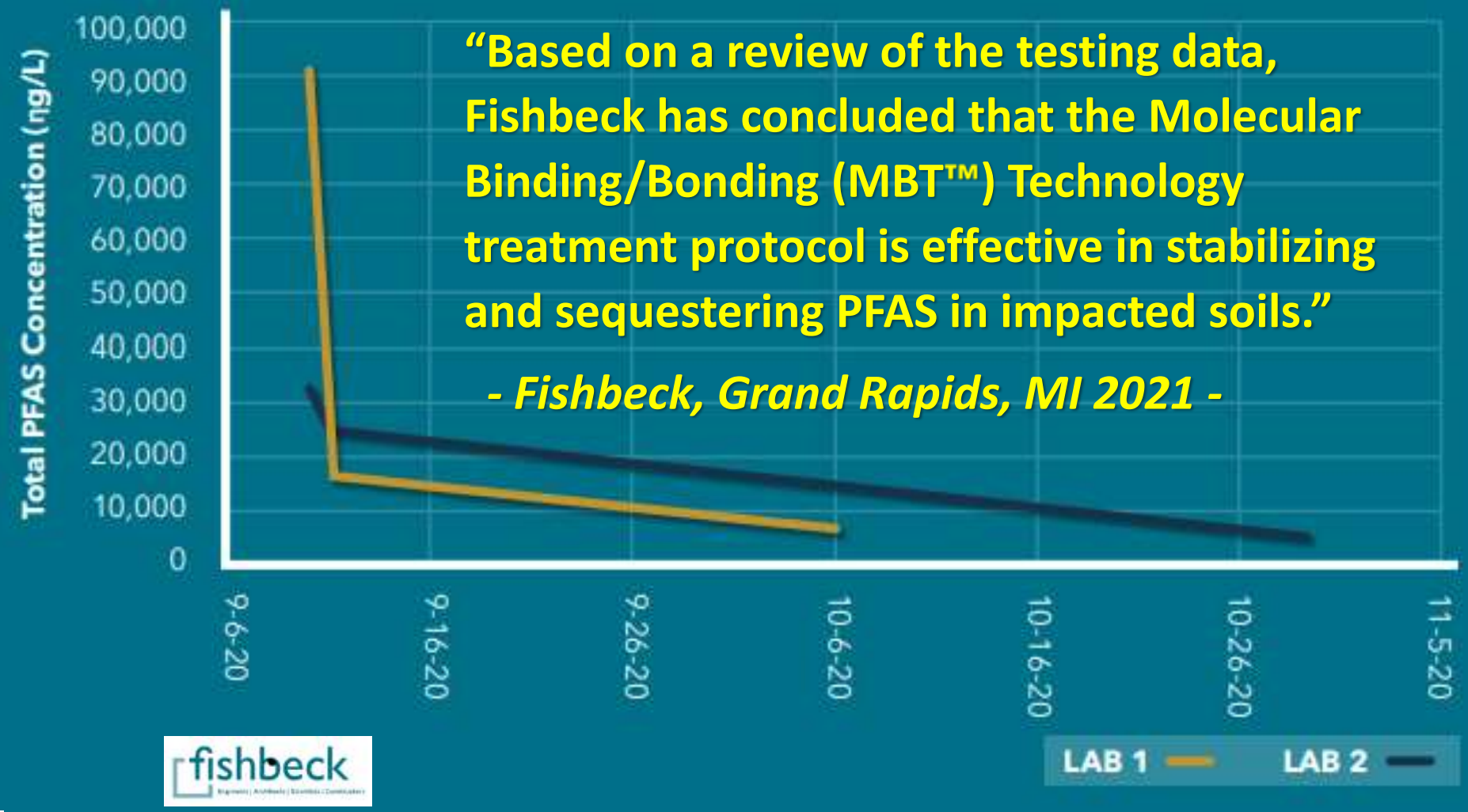
MBT – Treatment #1

Treated: August 28, 2020

TCLP Extraction Date = End of MBT Treatment Reactions

			TREATED: MBT-1			
		Date Treated/Sample ID:	08282020 - 1100			
		Laboratory:	FTCH: Fibertec/Trace		YB: ALS	
		Analysis Date:	9/9/2020	10/21/2020	9/11/2020	10/5/2020
			TCLP		TCLP	
PFAS Telomeres	**Chemical Name**	**C Atoms**	ng/L	ng/L	ng/L	ng/L
PFBA	Perfluorobutanoic Acid	C4	14	12	<50	<50
PFOA	**Perfluorooctanoic Acid**	**C8**	**35**	**21**	**12**	**<10**
PFUnA	Perfluoroundecanoic Acid	C11	<10	<10	2,800	<50
PFTriA	Perfluorortridecanoic Acid	C13	<20	<20	160	<50
PFHpS	Perfluoroheptanesulfonic Acid	C7	15	<10	<50	<50
PFOS	**Perfluorooctanesulfonic Acid**	**C8**	**22,000**	**4,400**	**9,700**	**900**
PFNS	Perfluorononanesulfonic Acid	C9	110	13	53	<50
PFDS	Perfluorodecanesulfonic Acid	C10	<20	<20	24	<10
PFOSA	Perfluorooctanesulfonaminde	C8	130	85	92	12
N-EtFOSSA	N-Ethyl perfluorooctane sulfonamido acetic acid	C12	2,500	860	3,700	360
N-MeFOSAA	N-Methylperfluorooctane sulfonamidoacetic acid	C11	<10	<10	<50	<50
	Summation of PFOA and PFOS:		**22,035**	**4,421**	**9,712**	**900**
	Summation of PFAS Telomere Totals):		24,804	5,391	16,602	1,272

MBT Treatment – TCLP Extraction



"Based on a review of the testing data, Fishbeck has concluded that the Molecular Binding/Bonding (MBT™) Technology treatment protocol is effective in stabilizing and sequestering PFAS in impacted soils."

- Fishbeck, Grand Rapids, MI 2021 -

fishbeck

Reduction of TOTAL PFAS – Bench Study Data

MBT Treatment Results of PFAS Telomeres in Flint Michigan Soil

Soil Provider: Job Site Services, Inc., Bay City, MI

PFAS in Soil as Totals (MS Semi-volatiles - EPA 537M BY ID)

Treatment Regime: / Matrix:				Untreated Soil	MBT-1 Soil	MBT-2 Soil	MBT-3 Soil	MBT-4 Soil
MBT Reagent (as %wt of as received sample)								
Total MBT reagent addition (w/out water)				0%	5.4%	13.0%	12.3%	7.6%
PFAS Telomere/Analyte	**Acronym**	**Fluorinated C Atoms**	**Units**					
Perfluorohexanoic acid	PFHXA	C_6	ug/kg	<0.21	<0.23	<0.23	<0.24	<0.22
Perfluoroheptanoic acid	PFHpA	C_7	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorooctanoic acid	PFOA	C_8	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorononanoic acid	PFNA	C_9	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorodecanoic acid	PFDA	C_{10}	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluoroundecanoic acid	PFUnA	C_{11}	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorododecanoic acid	PFDOA	C_{12}	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorotridecanoic acid	PFTriA	C_{13}	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorotetradecanoic acid	PFTeA	C_{14}	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorobutanesulfonic acid	PFBA	C_4	ug/kg	<0.26	<0.29	<0.29	<0.30	<0.28
Perfluorohexanesulfonic acid	**PFHxS**	**C_6**	**ug/kg**	**0.837 J**	**0.307 J**	<0.29	<0.30	**0.543 J**
Perfluorooctanesulfonic acid	**PFOS**	**C_8**	**ug/kg**	**13.9**	**3.93**	**2.76**	**2.77**	**7.21**
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	MeFOSAA	C_{11}	ug/kg	<0.52	<0.58	<0.59	<0.60	<0.56
N-ethyl perfluorooctane sulfonamido acetic acid	EtFOSAA	C_{12}	ug/kg	<0.52	<0.58	<0.59	<0.60	<0.56
pH			S.U.	9.32	7.18	5.87/6.20	4.07	8.80
Solids, Percent			%	95.3	85.7	85	80.8	88.6

MBT processing applied in four (4) different regimens: MBT-1, 2, 3, and 4

MBT is the patent-pending treatment technology owned by HMR Solutions, Inc. of Brooklyn, NY for leachable heavy metals, PFAS, and other constituents in soil, sediments, and other solid waste.

Analyses by SGS, Orlando FL

MBT – Pilot

Confidential Site Source, MI

General Summary Considerations

1. MBT process designed for 1M ng/Kg, performed at 15-17M ng/Kg
2. Reduced PFAS TCLP Leachability
3. Prolonged process reaction duration improves performance
4. Reduced total PFAS concentrations
5. Scalable

MC&E: MBT Soil **VIABILITY** Study (Eastern MI): 2023

Total and TCLP PFAS (ND's not shown)

			WA-01 UNTREATED		WA-01 MBT Treated	
		Matrix:	Soil	Soil	MBT-1 Treated Soil	MBT-2 Treated Soil
		Analysis Date:	9/21/2023	9/26/2023	9/24/2023	9/24/2023
		Methods:	E537 Mod	TCLP-1311/E537	TCLP-1311/E537	TCLP-1311/E537
			Total PFAS	TCLP	TCLP	TCLP
PFAS Telomeres	Chemical Name	C Atoms	(ng/Kg - dry wt.)	(ng/L)	(ng/L)	(ng/L)
PFBA	Perfluorobutanoic Acid	C4	<1200	7.9	<4.8	<5.3
PFPeA	Perfluoropentanoic Acid	C5	<1200	14	<4.8	<5.3
PFHxA	Perfluorohexanoic Acid	C6	1,600	86	<4.8	<5.3
PFHpA	Perfluoroheptanoic Acid	C7	<1200	15	<4.8	<5.3
PFOA	Perfluorooctanoic Acid	C8	5,200	220	3.1	12
PFNA	Perfluorononanoic Acid	C9	<1200	40	<4.8	<5.3
PFDA	Perfluorodecanoic Acid	C10	1,400	23	<4.8	<5.3
PFUnA	Perfluoroundecanoic Acid	C11	<1200	5.0	<4.8	<5.3
PFHxS	Perfluorohexanesulfonic Acid	C6	8,500	380	<4.8	5.7
PFHxSA	Perfluorohexanesulfonamide	C4	32,000	680	6.3	12
PFHpS	Perfluoroheptanesulfonic Acid	C7	<1200	23	<4.8	<5.3
PFOS	Perfluorooctanesulfonic Acid	C8	540,000	9,800	350	550
PFNS	Perfluorononanesulfonic Acid	C9	5,400	66	7.2	<5.3
PFDS	Perfluorodecanesulfonic Acid	C10	<1200	6.8	<4.8	<5.3
FtSA 8:2	Fluorotelomer Sulfonic Acid 8:2	C10	32,000	410	6.6	27
PFOSA	Perfluorooctanesulfonaminde	C8	180,000	840	120	86
C9H4F17NO2S	N-Methylperfluoro-1-octanesulfonamide	C-9	3,200	9.7	<4.8	<5.3
		Summation of PFOA and PFOS:	545,200	10,020	353	562
		Summation of Detected PFAS Telomeres:	809,300	12,642	493	706

MC&E: MBT Soil **VIABILITY** Study (Eastern MI): 2023

Total and SPLP MOD: SubD Landfill Leachate Extraction Fluid PFAS (ND's not shown)

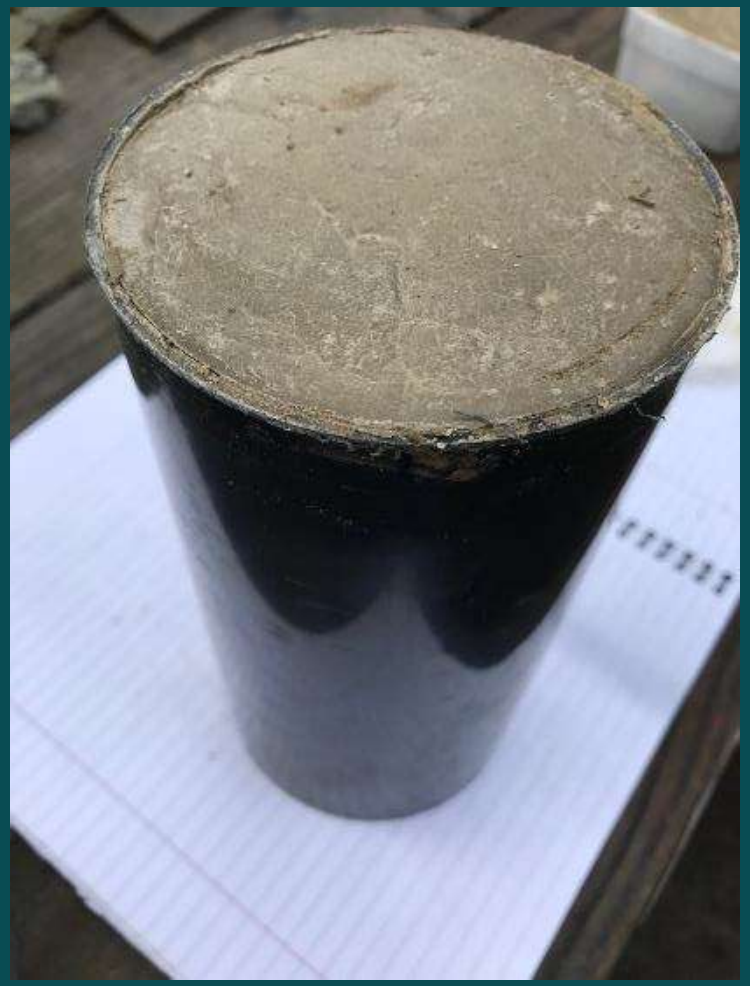
Michigan Consulting & Environmental

		WA-01 UNTREATED			WA-01 MBT Treated	
		Soil	Landfill Leachate	Soil	MBT-1 Treated Soil	MBT-2 Treated Soil
		9/21/2023	10/19/2023	9/24/2023	10/16/2023	10/16/2023
		E537 Mod	E537 Mod	SPLPMod-1312/E537 Mod	SPLP-Mod 1312/E537	SPLP-Mod 1312/E537
		Total PFAS	Total PFAS	SPLP-Mod	SPLP-Mod	SPLP-Mod
PFAS Telomeres	Chemical Name	(ng/Kg - dry wt.)	(ng/L)	(ng/L)	(ng/L)	(ng/L)
PFBA	Perfluorobutanoic Acid	<1200	680	410	610	650
PFPeA	Perfluoropentanoic Acid	<1200	1,100	920	630	540
PFHxA	Perfluorohexanoic Acid	1,600	2,300	1,700	1,600	1,500
PFHpA	Perfluoroheptanoic Acid	<1200	670	620	770	640
PFOA	Perfluorooctanoic Acid	5,200	1,500	1,400	1,200	960
PFNA	Perfluorononanoic Acid	<1200	58	89	39	41
PFDA	Perfluorodecanoic Acid	1,400	<50	41	<10	<10
PFUnA	Perfluoroundecanoic Acid	<1200	<50	<10	<10	<10
PFHxS	Perfluorohexanesulfonic Acid	8,500	1,300	1,200	940	820
PFHxSA	Perfluorohexanesulfonamide	32,000	<50	780	23	53
PFHpS	Perfluoroheptanesulfonic Acid	<1200	<50	30	<10	<10
PFOS	Perfluorooctanesulfonic Acid	540,000	280	18,000	750	570
PFNS	Perfluorononanesulfonic Acid	5,400	<50	91	<10	<10
PFDS	Perfluorodecanesulfonic Acid	<1200	<50	18	<10	<10
FtSA 8:2	Fluorotelomer Sulfonic Acid 8:2	32,000	<50	630	18	28
PFOSA	Perfluorooctanesulfonaminde	180,000	<50	3,100	340	140
C9H4F17NO2S	N-Methylperfluoro-1-octanesulfonamide	3,200	<50	27	<10	<10
		545,200	1,780	19,400	1,950	1,530
		809,300	22,210	41,916	19,179	17,246

MBT™ Technology for Leachable PFAS

- Yields a soil-like mass which retains PFAS at neutral pH
- PFAS not readily leached or extracted by contacting fluids or intense particle-to-particle abrasion
- Non-pozzolanic – NO hydroxides susceptible to neutralization and release of PFAS from exposure to acids, acidic conditions
- Treated mass passes Paint Filter Test. Further water loss via evaporation and capillary drying -- water is not incorporated into the treated mass as with cement or pozzolanic hydration. NO Free Liquids

Suitable for Supplemental Strengthening (e.g., sediments/slimes)



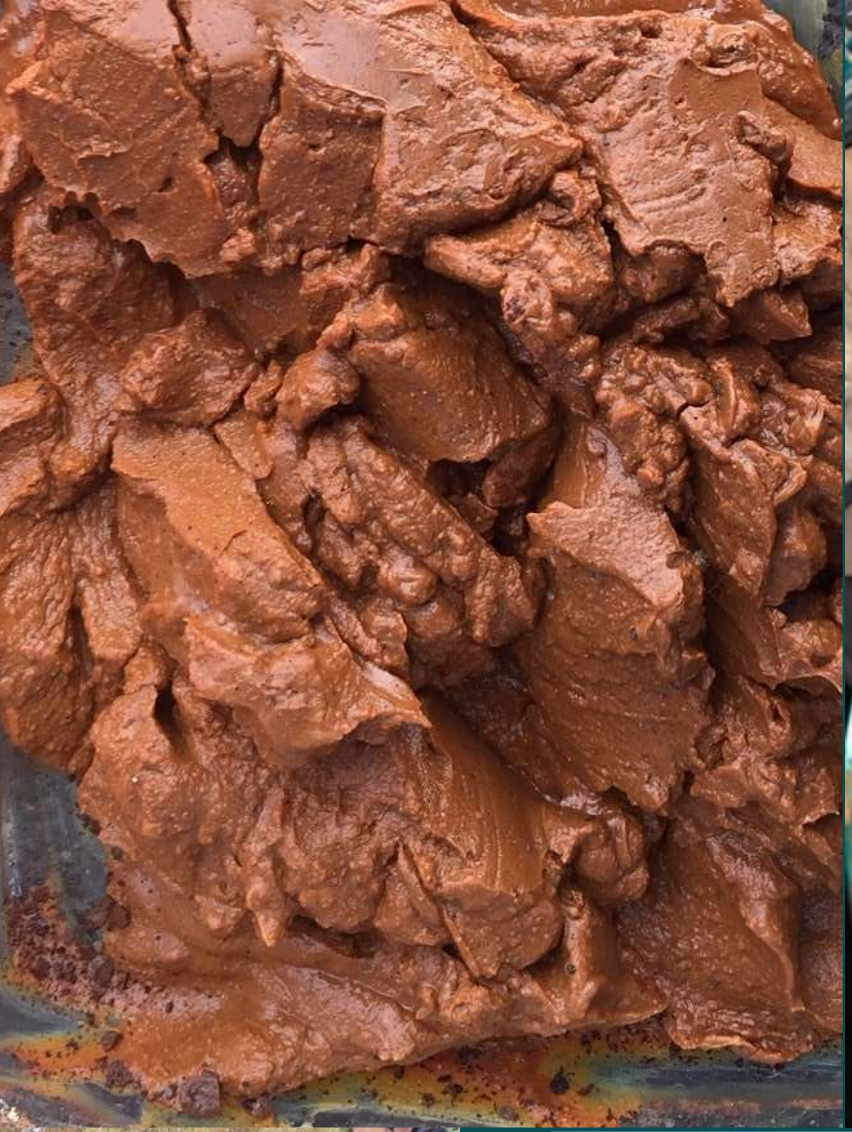
Supplement Strengthening Data (atypical additive need)

MBT Treated AN Solids - Compressive Strength (ASTM C-39)

Material	Treatment	Dose (% wt.)	7-day	28-day	Calculated* 28-day	Comments
AN Solids	PC Typ I/II	20	0	30	N/A	7-day broke during stripping
AN Solids	MBT-ES	20	820	N/A	1262	no filler aggregate added
AN Solids	MBT-ES	20	710	N/A	1092	no filler aggregate added
AN Solids + Fluvial Tailings	MBT-ES	20	1240	N/A	1908	w/tailing blend at 50:50

* 7-day psi extrapolated to 28-day assuming 7-day achieved 65% of strength at 28-days

Testing performed by GeoTest, Arlington, WA




MAXON

Advanced Neutralization (AN™) Pre-Treatment of Landfill Leachate:

Preparation for Onsite PFAS Destruction and Effluent Discharge

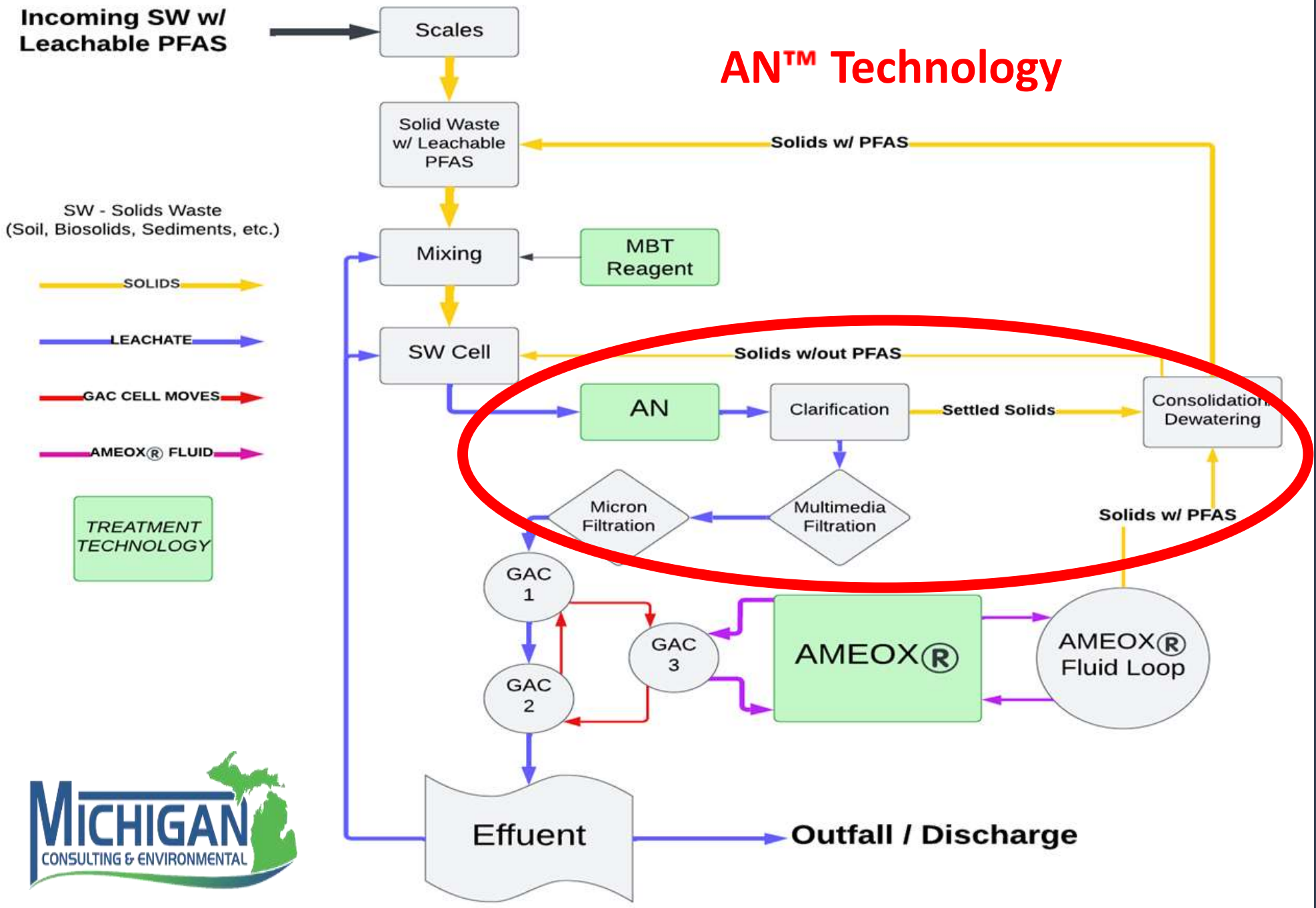
YB Technologies, LLC
Anacortes, WA

LANDFILL LEACHATE PFAS MANAGEMENT SOLUTION©

Breaking the PFAS Cycle

- CONFIDENTIAL -

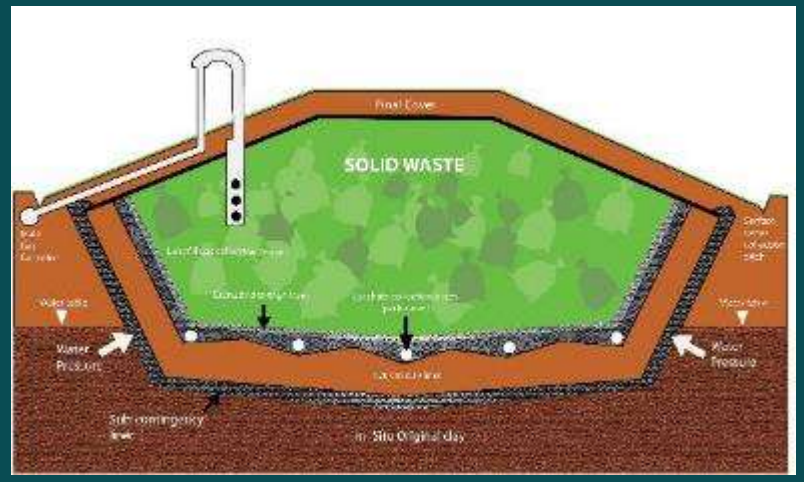
YB TECHNOLOGIES, LLC

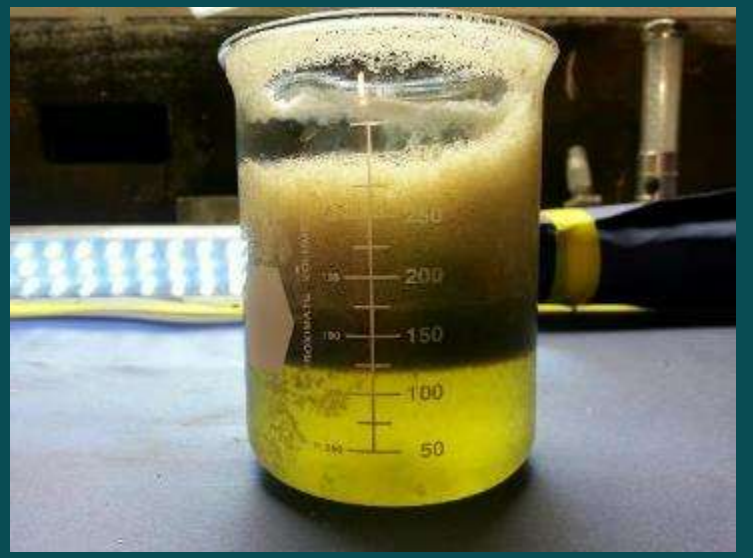


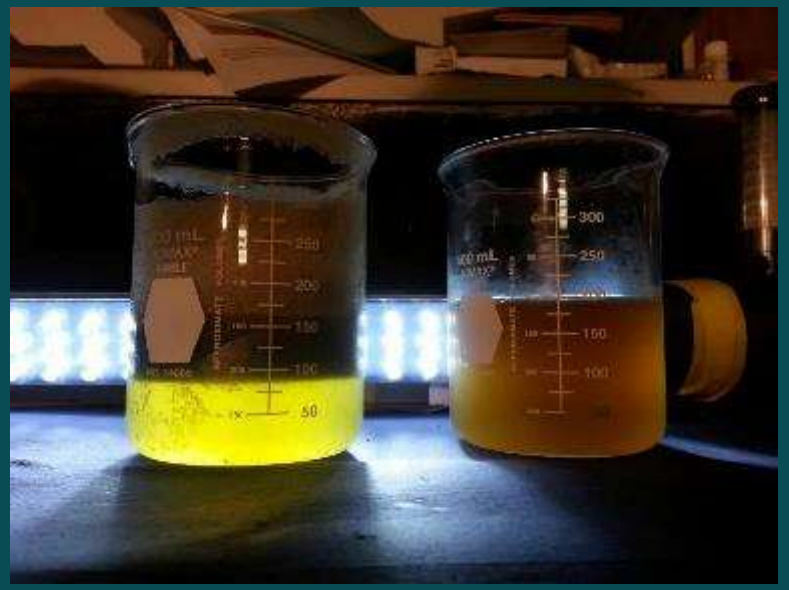
AN™ Technology

MICHIGAN CONSULTING & ENVIRONMENTAL

Subtitle D Landfill Leachate







Subtitle D Landfill Leachate:
AN Bench-Trial for COD/TSS/pH (2015)

- Non-Hazardous Landfill - OR
- Target Parameters: ***COD, TSS, pH***
- September 2015 (prior to PFAS)
- ~250 gallon sample volume
- Treated w/air and AN – 5 minutes
- Foam at ~28” above top of tank – 15 mins
- Study Halted – foam not controllable
- Study performed ***prior*** to PFAS knowledge

Subtitle D Landfill Leachate – Foam and COD Resolution

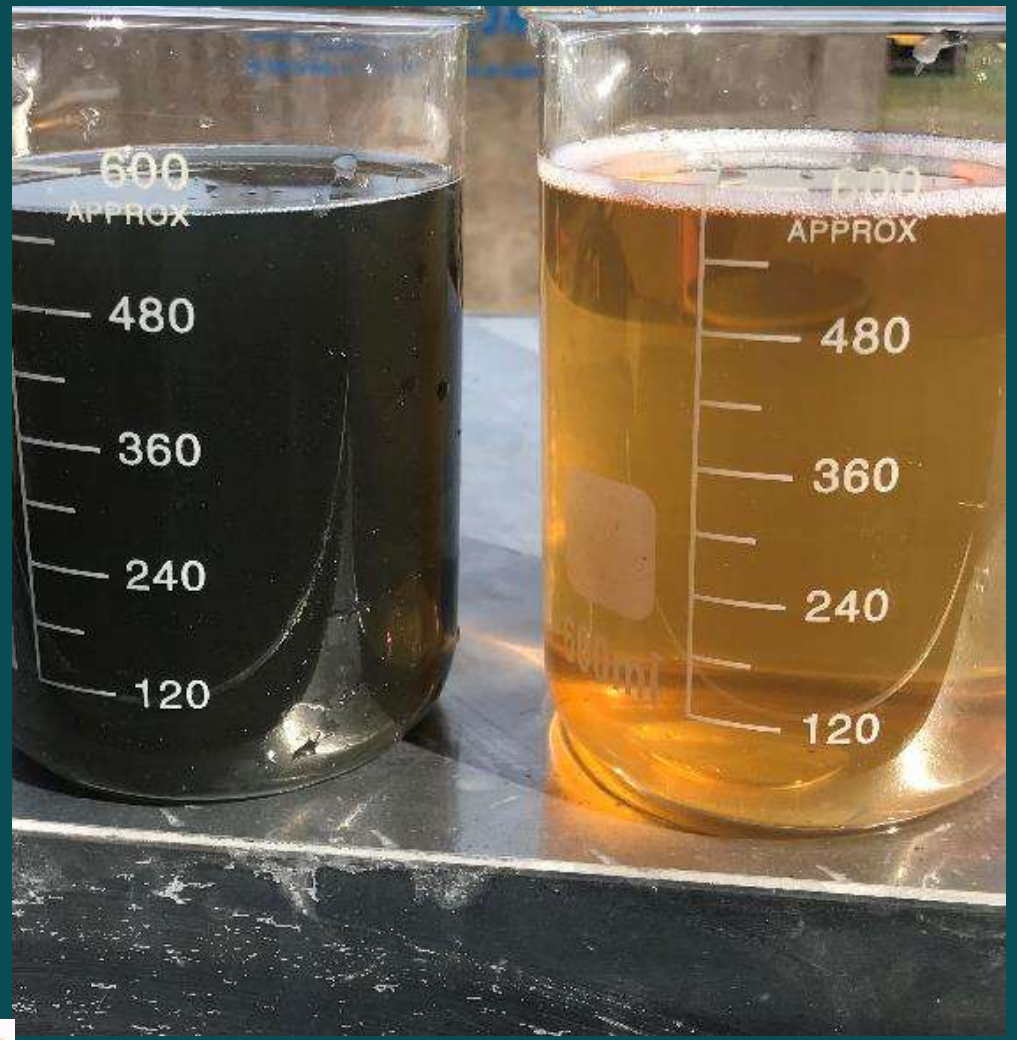
Sample ID	Result (mg/L)
Untreated	7375
AN-1	2275
AN-2	1650
AN-3	2600
AN-4	225

AN™ Treated Subtitle D Landfill Leachate (Oregon - 2015)

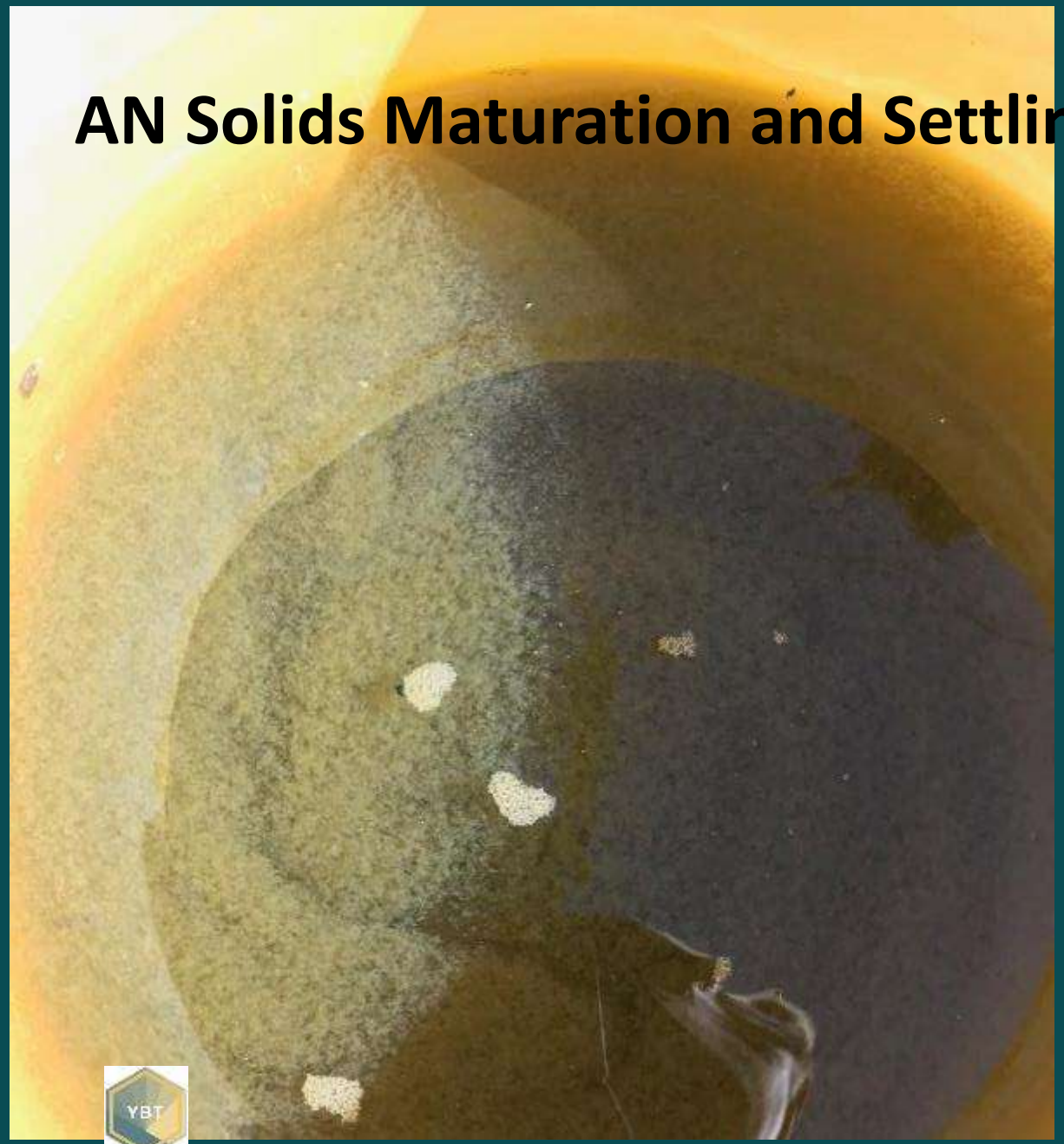
- Left: Untreated; Right : AN Viability Beaker Bench Tests (4)
- Far Right: Suitable for AMEOX™ Processing for PFAS

Foam Resolution Trials

Foaming Resolved



AN Solids Maturation and Settling

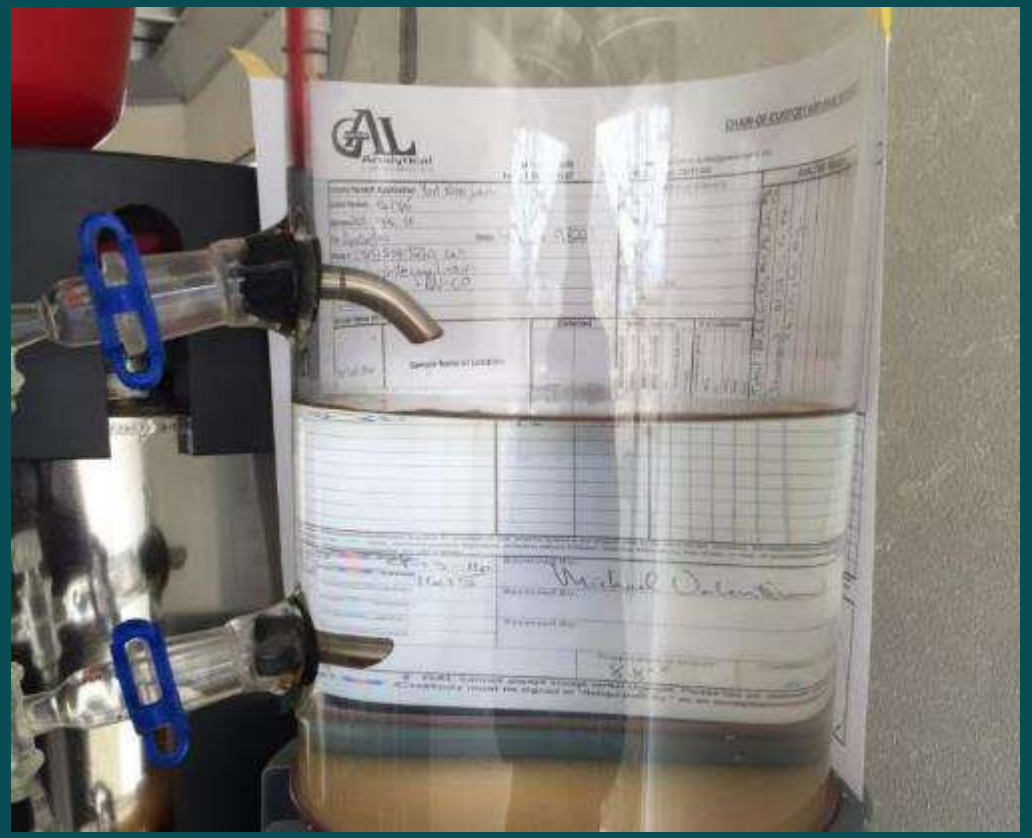


Advanced Neutralization™ for Leachate/Complex Wastewater

- Leachate Pre-treatment Process for subsequent PFAS removal
- AN™ uses electricity to treat acidity, and remove metals and solids from water, break emulsions/suspensions
- Forms hydroxides, neutralizes/destabilizes complex wastewater, forms precipitates which mature, densify, and settle by clarification
- Utilizes multiple electrolytic technologies, dimensionally stable and sacrificial electrodes and other reaction inducements with low power demand
- Addresses ORP for metals with multi-valent ionic forms and readily oxidizable constituents

Gold King Mine, Gladstone CO
12 gpm AN Pilot - 2015

AN Solids Maturation



Clarified AN Effluent @12 gpm

AN Solids Settling Times – Acid Mine Drainage

Left to Right:

2 minutes
5 minutes
7 minutes
10 minutes

30 minutes

AMEOX® Technology to Revitalize Carbon for Reuse

Onsite PFAS Destruction…

…in Spent Granular Activated Carbon

YB Technologies – Anacortes, WA

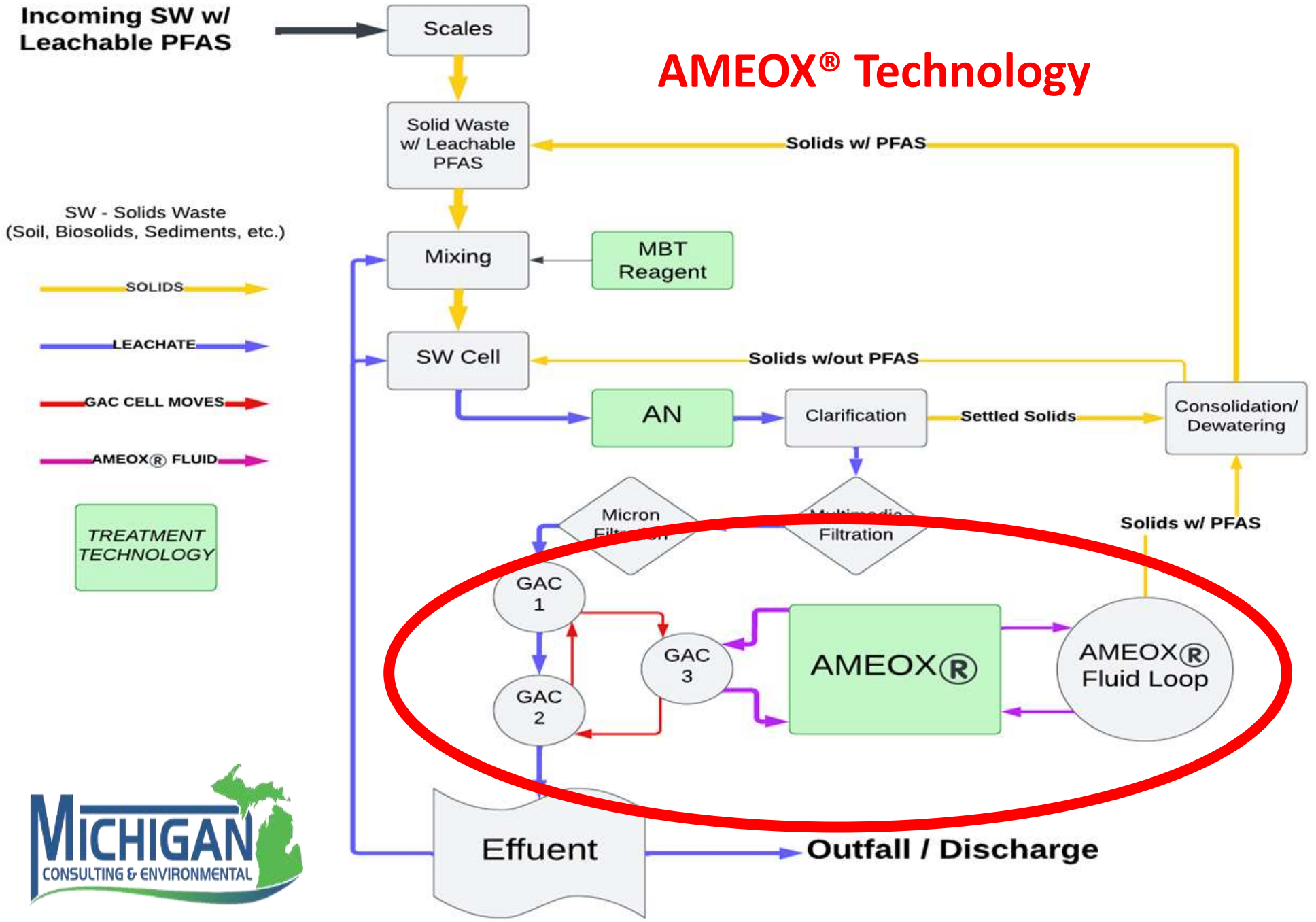
LANDFILL LEACHATE PFAS MANAGEMENT SOLUTION©

Breaking the PFAS Cycle

- CONFIDENTIAL -

YB TECHNOLOGIES, LLC

AMEOX® Technology



MICHIGAN CONSULTING & ENVIRONMENTAL

AMEOX® Technology – How It Works:

For Granular Activated Carbon (GAC):

- AMEOX equipment attaches to carbon vessel containing PFAS-spent GAC
- AMEOX Fluid delivers powerful oxidants to PFAS in GAC where PFAS is destroyed
- AMEOX Fluid recirculates: Equipment through carbon bed in vessel back to equipment
- Foulants (e.g., iron, calcium, aluminum, manganese) and inorganic fluoride are removed from AMEOX Fluid allowing for its continued/reuse without discharge

AMEOX® Dual Commercial Unit in Operation 2022- current

Dual Unit in 20’ Shipping Container

1000# GAC
Absorber Reactor

2000# GAC
Absorber Reactor

AMEOX® Technology Fact Sheet

- **>60-65% PFAS destruction in GAC creates effective capacity in GAC for its reuse**
- >99% destruction increases operating costs if desired.
- Electric Power Platform (240V/1-ph/50A service with propane heat)
- Stainless Steel Construction
- Skid-mounted (or trailer/shipping container housing)
- <1000 to 5000-10,000+# lb. media absorber reactor processing
- Re-usable AMEOX Fluid (oxidant carrier) with no discharge
- 2 pumps w/VFD per AMEOX Single Unit system (1 hp ea.)

AMEOX® Full-Scale Dual Commercial Unit
2022 - current

AMEOX™ Treatment Technology Defined

Electrochemical Oxidation

- Boron-Doped Diamond electrode surfaces on Niobium substrate
- Minimizes over-potential for water cleavage and maximizes electron transfer
- Dimensionally stable/non-sacrificial

Cavitation

- Cavitation is the formation and collapse of propagating bubbles in liquid
- Bubbles have internal temperature increases to thousands of deg-Kelvin and pressure to hundreds of bars
- Water vapor, oxygen and other constituents, are dissociated inside a bubble and yield oxidants such as ·OH, singlet O, ozone, peroxides, and others.

Sonolysis

- Ultrasonic energy creates propagating cavitation bubbles in water and generates oxidants
- Recognized technology for the destruction of organic pollutants in water
- Treatment results in the destruction of the C – F PFAS bonds
- PFAS molecules are reduced to fluoride ions and CO_2

AMEOX® Treatment Technology Components

- Electrochemical Oxidation (Boron-Doped Diamond Electrodes)
- Cavitation (multiple forms)
- Sonolysis
- Intimate robust contact static mixing
- Oxidant Regeneration
- Closed-loop AMEOX Fluid Processing (No discharge/re-useable fluid)
- In-media (carbon) & In-processor (desorbed) PFAS Destruction
- Oxidant Latency (**short-term half-life issues with hydroxyl radicals**)

AMEOX® Technology Oxidants

Oxidation Potential for Common Oxidants

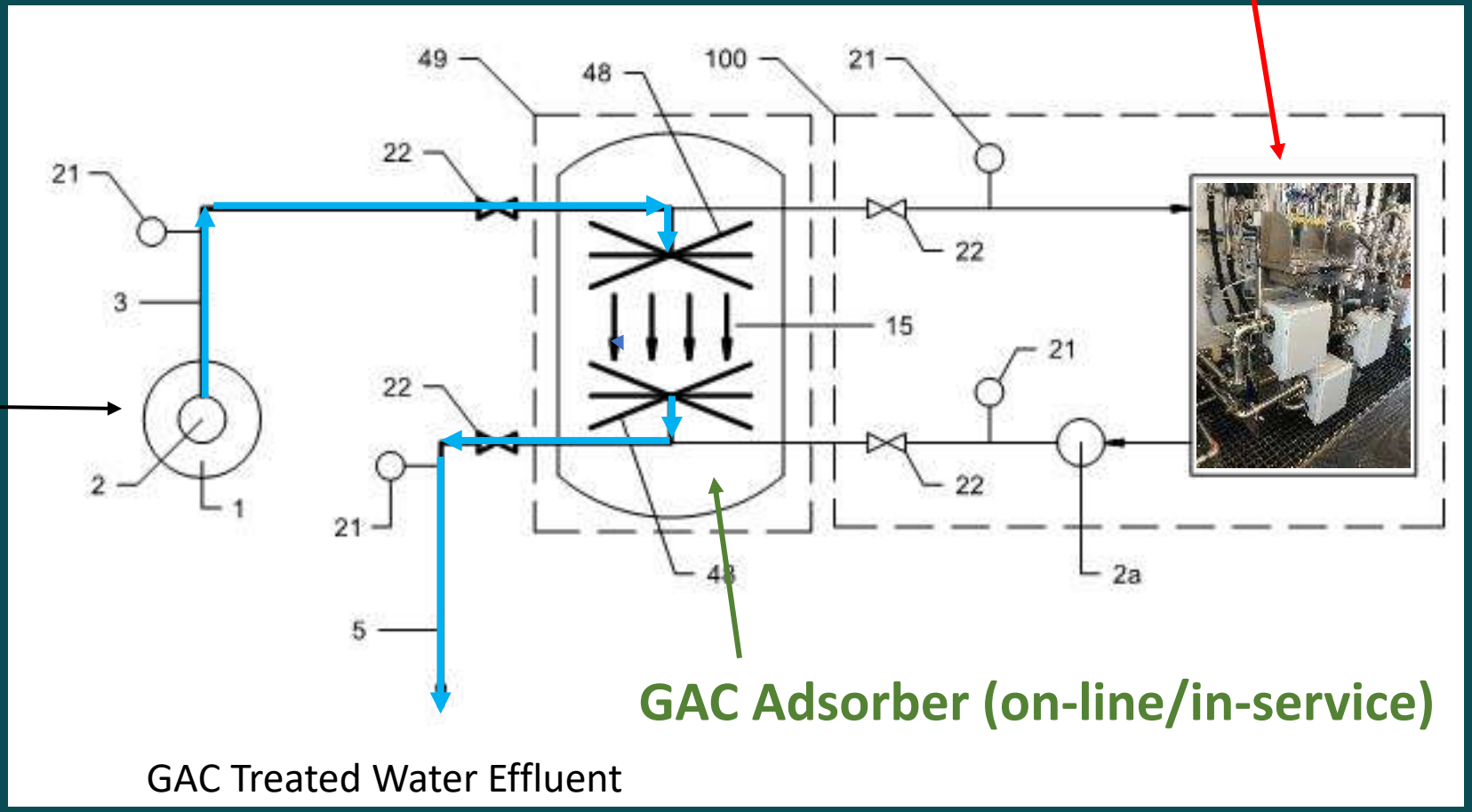
Oxidant	Oxidation Potential (V)
Fluorine (F_2)	3.0
Hydroxyl radical – acidic pH (•OH)	2.8
Sulfate radical ($•SO_4^-$)	2.6
Singlet (atomic) Oxygen (•O)	2.4
Ozone (O_3)	2.1
Persulfate ($S_2O_5^-$)	2.1
Hydroxyl radical – neutral pH (•OH)	1.8
Peroxymonosulfate (HSO_5^-)	1.8
Hydrogen Peroxide (H_2O_2)	1.8
Carbonate radical ($•CO_3^-$)	1.8
Perhydroxyl radical ($HO_2•$)	1.7
Percarbonate (as Sodium percarbonate)	1.6
Chlorine dioxide (ClO_2)	1.5
Chlorine (Cl_2)	1.4
Oxygen (O_2)	1.2
Hypochlorous Acid (HOCl)	0.95

2022 AMEOX Commercial Scale Dual Unit

Treatment System within a Conex Box allows for mobility

On-site AMEOX Spent GAC Processing

AMEOX™ System (off-line)

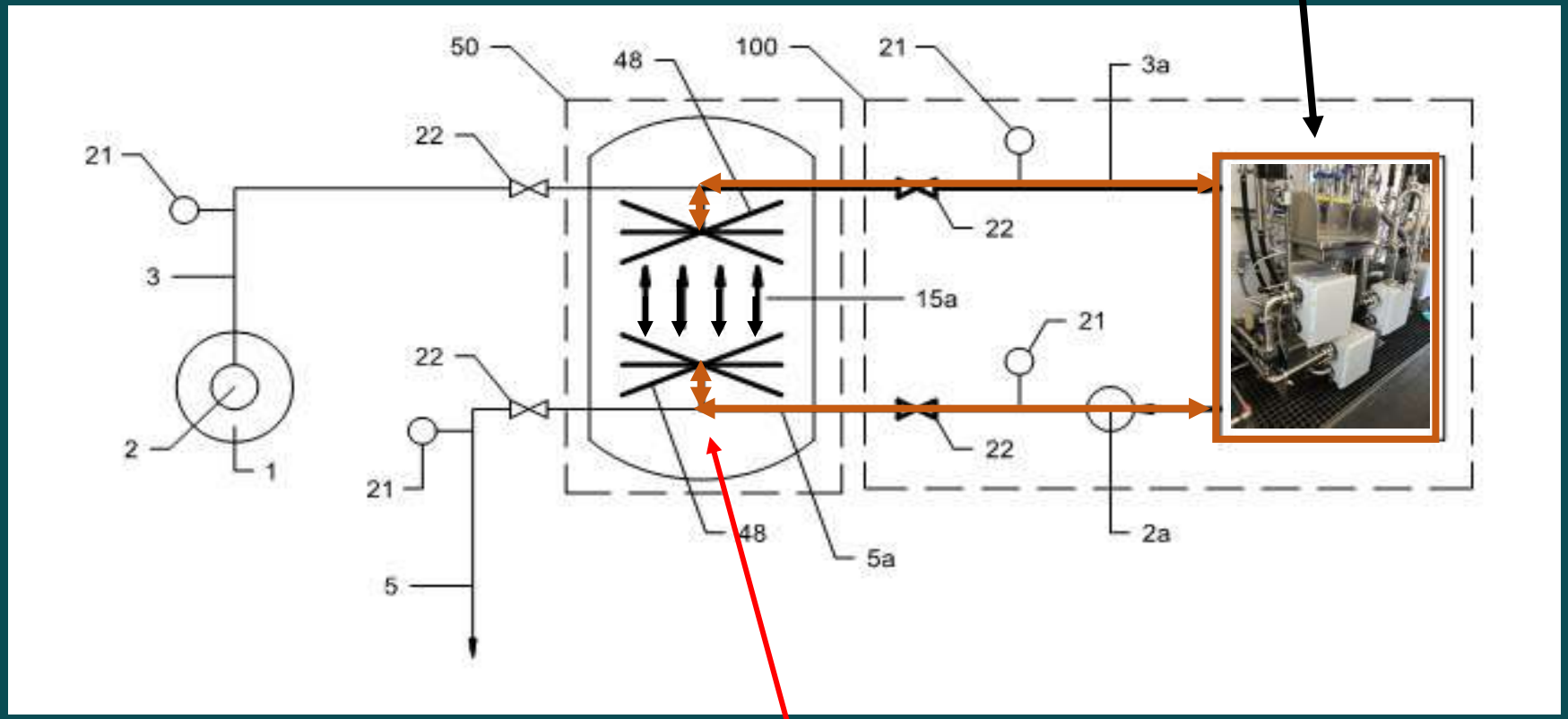


Raw Water

SEE OUR PFAS DESTRUCTION VIDEO: https://www.youtube.com/watch?v=L1jl7L7_rxo

On-site AMEOX Spent GAC Processing

AMEOX™ System (on-line/in-service)



GAC Adsorber (off-line/out of service/in treatment)

SEE OUR PFAS DESTRUCTION VIDEO: https://www.youtube.com/watch?v=L1jl7L7_rxo

On-site AMEOX Spent GAC Processing – Absorber Train

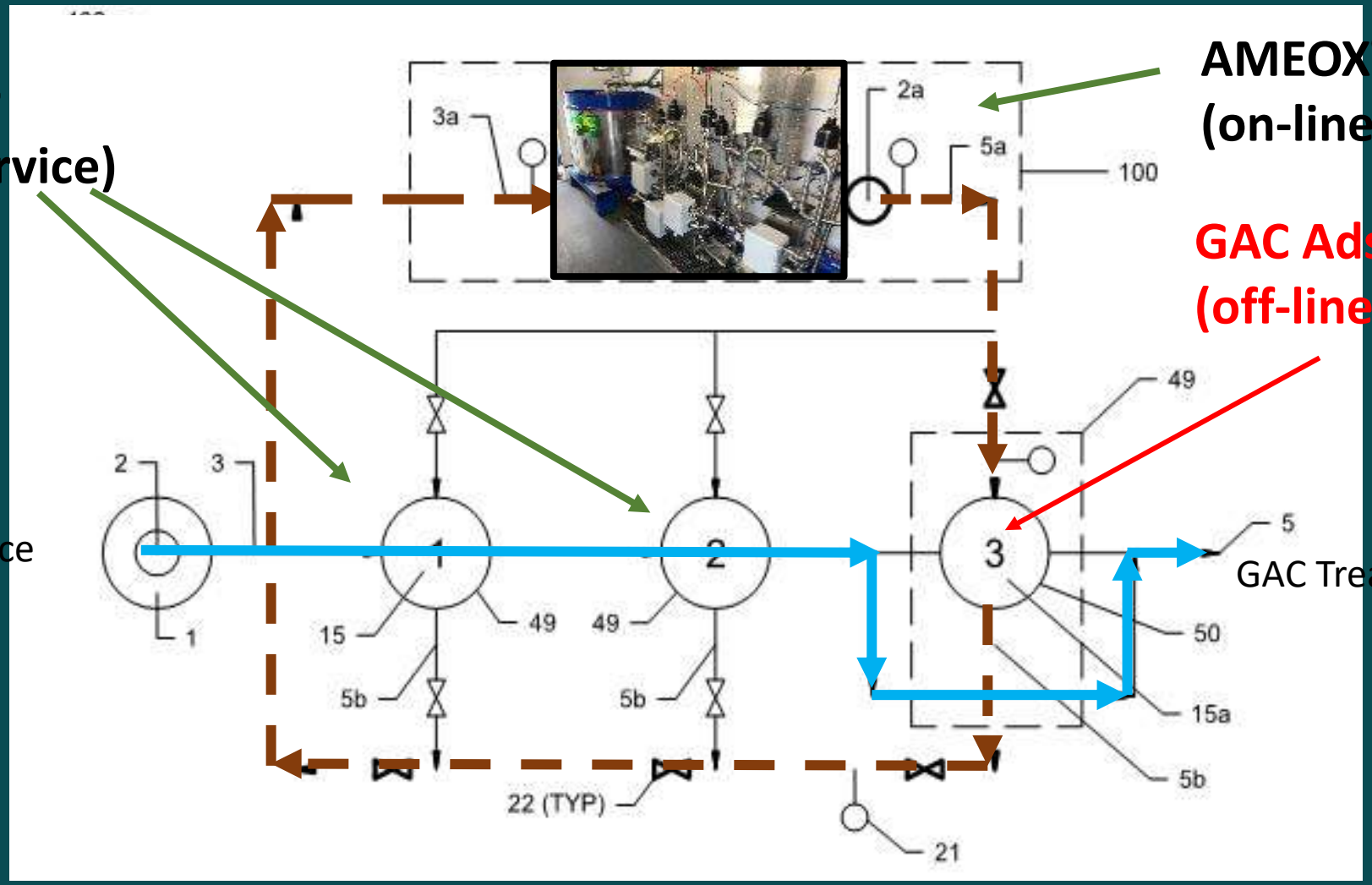
GAC Adsorber (on-line/in-service)

AMEOX™ System (on-line/in-service)

GAC Adsorber (off-line/in-treatment)

Raw Water Source

GAC Treated Water Effluent



AMEOX GAC Processing Data

PFOA & PFOS to <DL's

Bed-Depth Treatment Data

Waste Recovery Systems, Inc.
Wyoming, MI
July 2022

		Treatment Status:	**UNTREATED**	**TREATED**	**TREATED**
		Elapsed Treatment Time (Hrs.):	**T = 0**	**17.3**	**17.3**
		Matrix:	**GAC**	**GAC**	**GAC**
		1000# GAC Bed Depth Sample Location:	**Vertical Composite**	**Top 1/2**	**Bottom 1/2**
			TOTAL PFAS	**TOTAL PFAS**	**TOTAL PFAS**
PFAS Telomeres	**Chemical Name**	**C Atoms**	**(ng/Kg - dry wt.)**	**(ng/Kg - dry wt.)**	**(ng/Kg - dry wt.)**
PFBA	Perfluorobutanoic Acid	C4	**8,000**	**240**	**230**
PFPeA	Perfluoropentanoic Acid	C5	7,300	<120	<210
PFHxA	Perfluorohexanoic Acid	C6	<22,000	<120	<210
PFHpA	Perfluoroheptanoic Acid	C7	<22,000	<120	<210
PFOA	**Perfluorooctanoic Acid**	**C8**	**24,000**	**<25**	**<43**
PFNA	Perfluorononanoic Acid	C9	870	<25	<43
PFDA	Perfluorodecanoic Acid	C10	220	<120	<210
PFUnA	Perfluoroundecanoic Acid	C11	220	<120	<210
PFDoA	Perfluorododenoic Acid	C12	220	<120	<210
PFTriA	Perfluorortridecanoic Acid	C13	**220**	<120	<210
PFTeA	Perfluortetradecanoic Acid	C14	**220**	<120	<210
PFBS	Perfluorobutanesulfonic Acid	C4	**7,300**	**30**	<43
PFPeS	Perfluoropentanesulfonic Acid	C5	**2,900**	<25	<43
PFHxS	Perfluorohexanesulfonic Acid	C6	<22,000	<120	<210
PFHpS	Perfluoroheptanesulfonic Acid	C7	**5,400**	<120	<210
PFOS	**Perfluorooctanesulfonic Acid**	**C8**	**1,600,000**	**<25**	**<43**
PFNS	Perfluorononanesulfonic Acid	C9	**1,000**	<120	<210
PFDS	Perfluorodecanesulfonic Acid	C10	<44	<25	<43
FtSA 4:2	Fluorotelomer Sulfonic Acid 4:2	C6	<220	<120	<210
FtSA 6:2	Fluorotelomer Sulfonic Acid 6:2	C8	**8,400**	<120	<210
FtSA 8:2	Fluorotelomer Sulfonic Acid 8:2	C10	<220	<120	<210
PFOSA	Perfluorooctanesulfonaminde	C8	<44	<25	<43
N-EtFOSSA	N-Ethylperfluorooctranesulfonic	C12	<220	<120	<210
N-MeFOSAA	N-Methylperfluorooctranesulfonice	C11	<220	<120	<210
F-53BMin	11Cl-Pf3OUds	C10	<44	<25	<43
DONA	4,8-Doxa-3H-perfluorononanoic Acid	C8	<44	<25	<43
F-53BMaj	9Cl-PF3ONS	C8	<44	<25	<210
HFPO-DA	Hexafluoropropylene	C3	<220	<120	<210
% Moisture	% Moisture		**45**	**43**	**40**
	Summation of PFOA and PFOS:		**1,624,000**	**ND**	**ND**
	Summation of PFAS Telomeres:		**1,666,270**	**270**	**230**
Lab testing by ALS, Holland, MI				>99%	>99%

AMEOX GAC Processing Data

AMEOX Treated GAC
Returned to Service – Landfill Leachate Treatment
Waste Recovery Systems, Inc., Wyoming, MI

As of October 19, 2022:

- **Use #1:** Originally used on PFAS groundwater pump & treat system >>AMEOX treated (data on right >>>>>)
- **Use #2:** Landfill leachate decant >> AMEOX treated
- **Use #3:** Landfill leachate decant

			UNTREATED	Treated
		Lab:	ALS	ALS
		Sample ID:	06272022-1015	07252022-1020
		Elapsed Treatment Time (Hrs.)	0	37.6
		Matrix:	GAC	GAC
		Supplemental Processing:		
			Total PFAS	Total PFAS
PFAS Telomeres	Chemical Name	C Atoms	(ng/Kg - dry wt.)	(ng/Kg - dry wt.)
PFBA	Perfluorobutanoic Acid	C4	**4,100**	1,700
PFPeA	Perfluoropentanoic Acid	C5	**4,600**	1,700
PFHxA	Perfluorohexanoic Acid	C6	<29,000	4,000
PFHpA	Perfluoroheptanoic Acid	C7	<29,000	2,400
PFOA	**Perfluorooctanoic Acid**	**C8**	**47,000**	**8,400**
PFNA	Perfluorononanoic Acid	C9	**560**	200
PFDA	Perfluorodecanoic Acid	C10	**610**	<250
PFUnA	Perfluoroundecanoic Acid	C11	<290	<250
PFDoA	Perfluorododenoic Acid	C12	<290	<250
PFTriA	Perfluorortridecanoic Acid	C13	<290	<250
PFTeA	Perfluortetradecanoic Acid	C14	<290	<250
PFBS	Perfluorobutanesulfonic Acid	C4	**31,000**	3,100
PFPeS	Perfluoropentanesulfonic Acid	C5	**8,700**	830
PFHxS	Perfluorohexanesulfonic Acid	C6	**59,000**	4,200
PFHpS	Perfluoroheptanesulfonic Acid	C7	62,000	3,900
PFOS	**Perfluorooctanesulfonic Acid**	**C8**	**7,500,000**	**780,000**
PFNS	Perfluorononanesulfonic Acid	C9	**1,300**	<250
PFDS	Perfluorodecanesulfonic Acid	C10	<59	<51
FtSA 4:2	Fluorotelomer Sulfonic Acid 4:2	C6	<290	<250
FtSA 6:2	Fluorotelomer Sulfonic Acid 6:2	C8	**3,400**	<250
FtSA 8:2	Fluorotelomer Sulfonic Acid 8:2	C10	<290	<250
PFOSA	Perfluorooctanesulfonaminde	C8	67	<51
N-EtFOSSA	N-Ethylperfluorooctranesulfonic	C12	<290	<250
N-MeFOSAA	N-Methylperfluorooctranesulfonice	C11	<290	<250
F-53BMin	11Cl-Pf3OUds	C10	<59	<51
DONA	4,8-Doxa-3H-perfluorononanoic Acid	C8	<59	<51
F-53BMaj	9Cl-PF3ONS	C8	<59	<51
HFPO-DA	Hexafluoropropylene	C3	<290	<250
% Moisture	% Moisture		**58**	55
	Summation of PFOA and PFOS:		**7,547,000**	**788,400**
	Summation of PFAS Telomeres:		**7,722,337**	**810,430**
Lab testing by ALS, Holland, MI				-89.6%
				-89.5%

AMEOX® Dual Commercial Unit in Operation (January 2024)

10,000# Trailered GAC Absorbers (2 on left)
AMEOX Dual Unit in 20’ Shipping Container (rt.)

AMEOX GAC Processing (-8°F)

AMEOX GAC Processing Data – 10K# Lead Cell

>80% PFAS Destruction

High Level Metals Removal

Rejuvenated GAC for Re-Use In May 2024

			Source:	CONFIDENTIAL 10,000# GAC - Absorber Cell 1 (Lead)		
GAC and Absorber			Sample Type:	Untreated PFAS GAC	AMEOX Treated	
(2) 10k lbs. carbon cells on semi trailer			Analytes:	PFAS Totals/ Metals	PFAS Totals/ Metals	
Lead Cell 1 (9,000 lbs.) - Located at front of trailer			Matrix:	GAC	GAC	
Lag Cell 2 (9,000 lbs.) - Located at rear of trailer			Phase:	CHARACTERIZATION	Post Treatment	
			Sample ID:	11302023-1445	02082024W-0830	
			Method:	E-537 Mod	E-537 Mod	
			Units (unless noted):	(ng/Kg-dry wt.)	(ng/Kg-dry wt.)	% Reduction
Telomere	Chemical Name	CAS No.	C Atoms	Result	Result	
FtSA 6:2	Fluorotelomer Sulfonic Acid 6:2	27619-97-2	C8	<1800	3,900	ND
PFBS	**Perfluorobutanesulfonic Acid**	**375-73-5**	**C4**	**11,000**	**3,800**	**-65.5%**
PFBA	**Perfluorobutanoic Acid**	**375-22-4**	**C4**	**40,000**	**26,000**	**-35.0%**
PFHpS	Perfluoroheptanesulfonic Acid	375-92-8	C7	15,000	4,000	-73.3%
PFHpA	Perfluoroheptanoic Acid	375-85-9	C7	15,000	5,000	-66.7%
PFHxS	**Perfluorohexanesulfonic Acid**	**355-46-4**	**C6**	**37,000**	**11,000**	**-70.3%**
PFHxA	**Perfluorohexanoic Acid**	**307-24-4**	**C6**	**14,000**	**7,100**	**-49.3%**
PFNA	**Perfluorononanoic Acid**	**375-95-1**	**C9**	**6,300**	**2,400**	**-61.9%**
PFOS	**Perfluorooctanesulfonic Acid**	**1763-23-1**	**C8**	**520,000**	**74,000**	**-85.8%**
PFOA	**Perfluorooctanoic Acid**	**335-67-1**	**C8**	**29,000**	**12,000**	**-58.6%**
PFPeS	**Perfluoropentanesulfonic Acid**	**2706-91-4**	**C5**	**8,800**	**3,000**	**-65.9%**
PFPeA	**Perfluoropentanoic Acid**	**2706-90-3**	**C5**	**8,400**	**5,000**	**-40.5%**
HFPO-DA	**Hexafluoropropylene oxide dimer acid**	**13252-13-6**	**C6**	**<1800**	**<2100**	
PFecHS	**Perfluoro-4-ethylcyclohexanesulfonic Acid**	**646-83-3**	**C8**	**880,000**	**140,000**	**-84.1%**
Al	**Aluminum**		**mg/Kg**	**1,600**	**400**	**-75.0%**
Ca	**Calcium**		**mg/Kg**	**3,800**	**98**	**-97.4%**
Fe	**Iron**		**mg/Kg**	**6,800**	**3,700**	**-45.6%**
Mn	**Manganese**		**mg/Kg**	**430**	**NA**	**-98.1%**
% Moisture				**45**	**53**	
			Summation of PFOA and PFOS:	**549,000**	**86,000**	**-84.3%**
			*** Summation of PFOA, PFOS, PFNA, PFHxS, PFBS, HFPO-DA (GenX):**	**603,300**	**103,200**	**-82.9%**
			Summation of PFAS Telomere Totals:	**1,573,500**	**289,500**	**-81.6%**

Non-detected PFAS telomeres not shown

AMEOX GAC Processing Data – 10K# Lag Cell

80% PFAS Destruction

High Level Metals Removal

Rejuvenated GAC for Re-Use In May 2024

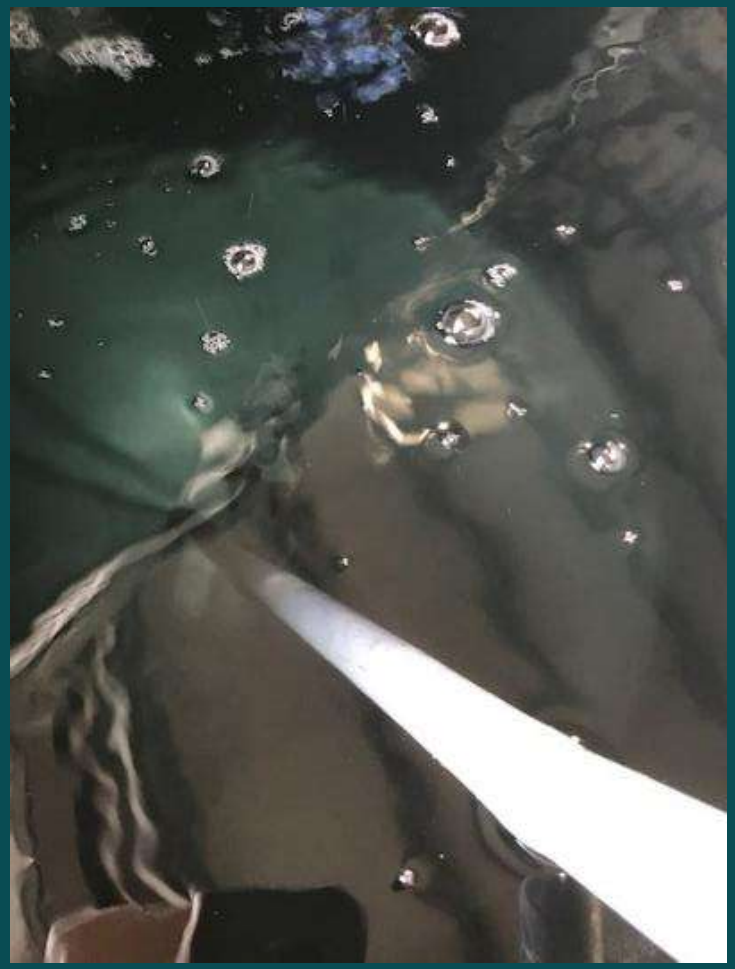
GAC and Absorber

(2) 10k lbs. carbon cells on semi trailer
Lead Cell 1 (9,000 lbs.) - Located at front of trailer
Lag Cell 2 (9,000 lbs.) - Located at rear of trailer

				CONFIDENTIAL 10,000# GAC - Absorber Cell 2 (Lag)		
			Sample Type:	Untreated PFAS GAC	AMEOX Treated	
			Analytes:	PFAS Totals/ Metals	PFAS Totals/ Metals	
			Matrix:	GAC	GAC	
			Treatability Phase:	CHARACTERIZATION	Post Treatment	
			Sample Source:	Lag Cell 2	Lag Cell 2	
			Sample ID:	11302023-1400	01282024W-1100	
			Method:	E-537 Mod	E-537 Mod	
			Units (unless noted):	(ng/Kg-dry wt.)	(ng/Kg-dry wt.)	% Reduction
Telomere	Chemical Name	CAS No.	C Atoms	Result	Result	Result
FtSA 6:2	Fluorotelomer Sulfonic Acid 6:2	27619-97-2	C8	1,900	<2200	ND
PFBS	**Perfluorobutanesulfonic Acid**	**375-73-5**	**C4**	**8,900**	**2,800**	**-68.5%**
PFBA	**Perfluorobutanoic Acid**	**375-22-4**	**C4**	**32,000**	**26,000**	**-18.8%**
PFHpS	Perfluoroheptanesulfonic Acid	375-92-8	C7	9,800	3,100	-68.4%
PFHpA	Perfluoroheptanoic Acid	375-85-9	C7	14,000	4,400	-68.6%
PFHxS	**Perfluorohexanesulfonic Acid**	**355-46-4**	**C6**	**29,000**	**9,100**	**-68.6%**
PFHxA	**Perfluorohexanoic Acid**	**307-24-4**	**C6**	**14,000**	**7,200**	**-48.6%**
PFNA	**Perfluorononanoic Acid**	**375-95-1**	**C9**	**5,900**	**2,300**	**-61.0%**
PFOS	**Perfluorooctanesulfonic Acid**	**1763-23-1**	**C8**	**400,000**	**68,000**	**-83.0%**
PFOA	**Perfluorooctanoic Acid**	**335-67-1**	**C8**	**30,000**	**11,000**	**-63.3%**
PFPeS	**Perfluoropentanesulfonic Acid**	**2706-91-4**	**C5**	**6,700**	**2,200**	**-67.2%**
PFPeA	**Perfluoropentanoic Acid**	**2706-90-3**	**C5**	**7,400**	**4,000**	**-45.9%**
HFPO-DA	**Hexafluoropropylene oxide dimer acid**	**13252-13-6**	**C6**	**<1800**	**<2200**	
PFecHS	**Perfluoro-4-ethylcyclohexanesulfonic Acid**	**646-83-3**	**C8**	**950,000**	**170,000**	**-82.1%**
Al	**Aluminum**		**mg/Kg**	**1,800**	**400**	**-77.8%**
Ca	**Calcium**		**mg/Kg**	**3,100**	**120**	**-96.1%**
Fe	**Iron**		**mg/Kg**	**5,100**	**3,200**	**-37.3%**
Mn	**Manganese**		**mg/Kg**	**98**	**6.4**	**-93.5%**
% Moisture				**42**	**55**	
			Summation of PFOA and PFOS:	**430,000**	**79,000**	**-81.6%**
			*** Summation of PFOA, PFOS, PFNA, PFHxS, PFBS, HFPO-DA (GenX):**	**473,800**	**93,200**	**-80.3%**
			Summation of PFAS Telomere Totals:	**1,509,600**	**310,100**	**-79.5%**

Non-detected PFAS telomeres not shown

Recirculating PFAS Fluid – AMEOX Dual Unit in Operation (January 2024)



AMEOX Performance Indicators:

1. Decrease in PFAS telomere concentrations
2. Carbon dioxide – low level (ppt) real-time monitoring not viable
3. ***Fluoride*** increase in AMEOX Processing Fluid:

Program	Parameter	Pre-AMEOX	Post-AMEOX
2020 - Prineville, OR	F^- (mg/L)	<0.1	**0.21**
2022- Wyoming, MI	F^- (mg/L)	0.8	**7.48**
2023-24 Wyoming, MI	F^- (mg/L)	0.8	**41.6**

4. ***Iron/Calcium*** **in GAC**

2022 – Wyoming, MI	Iron (mg/Kg)	18,000	**2,500**
2024 – Wyoming, MI	Calcium (mg/Kg)	9,300	**2,200**

AMEOX® Technology for PFAS Destruction (August 2022)

Beneficial Iron Removal from Spent GAC

Untreated GAC: **18,000 mg/Kg**
Treated GAC: **2,500 mg/Kg**

AMEOX® Fluid

Re-Use Data (2023-2024)

- PFAS “ND” in AMEOX fluid & settled solids.
- Inorganic Fluoride generated during PFAS destruction and removed from fluid with Al, Ca, Fe, and Mn foulants.
- F^- background in city makeup water for AMEOX fluid was 0.8 mg/L. Foulant metals sourced from carbon.
- AMEOX fluid returned for re-use to destroy PFAS in GAC.

AMEOX Fluid and Solids			Source:	Cone Tank	
AMEOX fluid = Supernate after solids settling and decant			Sample Type:	Supernate Decant	Settled Solids
Solids = Solids after settling and decant of AMEOX fluid			Analytes:	PFAS Totals/ Metals	PFAS Totals/ Metals
Solids accumulated for nearly 1 year			Matrix:	AMEOX Fluid	Solids
			Lab:	ALS	ALS
			PFAS Method:	E-537 Mod	E-537 Mod
			Units (unless noted):	(ng/L)	(ug/Kg-dry wt.)
Telomere	Chemical Name	CAS No.	C Atoms	Result	Result
FtSA 4:2	Fluorotelomer Sulfonic Acid 4:2	757124-72-4	C6	<5.0	<35
FtSA 6:2	Fluorotelomer Sulfonic Acid 6:2	27619-97-2	C8	<5.0	<35
FtSA 8:2	Fluorotelomer Sulfonic Acid 8:2	39108-34-4	C10	<5.0	<35
FtSA 10:2	Fluorotelomer Sulfonic Acid 10:2	120226-60-0	C12	<5.0	<35
PFBS	**Perfluorobutanesulfonic Acid**	**375-73-5**	**C4**	<5.0	<35
PFBA	**Perfluorobutanoic Acid**	**375-22-4**	**C4**	<5.0	<35
PFDS	Perfluorodecanesulfonic Acid	335-77-3	C10	<5.0	<35
PFDA	Perfluorodecanoic Acid	335-76-2	C10	<5.0	<35
PFDoS	Perfluorododecanesulfonic Acid	79780-39-5	C12	<5.0	<35
PFDoA	Perfluorododenoic Acid	307-55-1	C12	<5.0	<35
PFHpS	Perfluoroheptanesulfonic Acid	375-92-8	C7	<5.0	<35
PFHpA	Perfluoroheptanoic Acid	375-85-9	C7	<5.0	<35
PFHxDA	Perfluorohexadecanoic Acid	67905-19-5	C16	<5.0	<35
PFHxS	**Perfluorohexanesulfonic Acid**	**355-46-4**	**C6**	<5.0	<35
PFHxA	**Perfluorohexanoic Acid**	**307-24-4**	**C6**	<5.0	<35
PFNS	Perfluorononanesulfonic Acid	68259-12-1	C9	<5.0	<35
PFNA	**Perfluorononanoic Acid**	**375-95-1**	**C9**	<5.0	<35
PFODA	Perfluorooctadecanoic Acid	16517-11-6	C18	<5.0	<35
PFOSA	Perfluorooctanesulfonaminde	754-91-6	C8	<5.0	<35
PFOS	**Perfluorooctanesulfonic Acid**	**1763-23-1**	**C8**	<5.0	<35
PFOA	**Perfluorooctanoic Acid**	**335-67-1**	**C8**	<5.0	<35
PFPeS	**Perfluoropentanesulfonic Acid**	**2706-91-4**	**C5**	<5.0	<35
PFPeA	**Perfluoropentanoic Acid**	**2706-90-3**	**C5**	<5.0	<35
PFTeA	Perfluortetradecanoic Acid	376-06-7	C14	<5.0	<35
PFTrDA	Perfluorortridecanoic Acid	72629-94-8	C13	<5.0	<35
PFUnA	Perfluoroundecanoic Acid	2058-94-8	C11	<5.0	<35
	N-ethylperfluoro-1-octanesulfonamide	936109-40-9	C10	<5.0	<35
N-EtFOSSA	N-Ethylperfluorooctanesulfonamidoacetic Acid	2991-50-6	C12	<5.0	<35
	N-Ethylperfluorooctanesulfonamidoethanol	N/A	C12	<5.0	<35
N-MeFOSA	N-methylperfluoro-1-octanesulfonamide	31506-32-8	C9	<5.0	<35
N-MeFOSAA	N-Methylperfluorooctanesulfonamidoacetic Acid	2355-31-9	C11	<5.0	<35
N-MeFOSE	N-Methylperfluorooctanesulfonamidoethanol	24448-09-7	C11	<5.0	<35
HFPO-DA	**Hexafluoropropylene oxide dimer acid**	**13252-13-6**	**C6**	<5.0	<35
ADONA	4,8-Dioxa-3H-perfluorononanoic Acid	919005-14-4	C8	<5.0	<35
F-53BMin	11Cl-PF3OUds	763051-92-9	C10	<5.0	<35
F-53BMaj	9Cl-PF3ONS	756426-58-1	C8	<5.0	<35
PFecHS	**Perfluoro-4-ethylcyclohexanesulfonic Acid**	**646-83-3**	**C8**	<5.0	<35
PFBSA	Perfluorobutylsulfonamide	30334-69-1	C4	<5.0	<35
PFHxSA	Perfluorohexanesulfonamide	41997-13-1	C6	<5.0	<35
Parameter					
F^-	**Fluoride (SW9056A)**			**<0.40 mg/L**	**41.6**
Al	**Aluminum (SW3015A / 3050B)**			**0.11 mg/L**	**15,000**
Ca	**Calcium (SW3015A / 3050B)**			**330 mg/L**	**100,000**
Fe	**Iron (SW3015A / 3050B)**			**0.26 mg/L**	**42,000**
Mn	**Manganese (SW3050B)**			**N/A**	**20,000**
% Moisture	**Moisture (SW3550C)**		**% of sample:**	**N/A**	**97**
			Summation of PFOA and PFOS:	**Non-Detect**	**Non-Detect**
			*** Summation of PFOA, PFOS, PFNA, PFHxS, PFBS, HFPO-DA (GenX):**	**Non-Detect**	**Non-Detect**
			Summation of PFAS Telomere Totals:	**Non-Detect**	**Non-Detect**

AMEOX® Treated Carbon

Inorganic Parameters (2023-24)

Parameter	Untreated GAC	AMEOX Treated GAC
Iron	18,000	2500
Aluminum	5100	2600
Calcium	9300	2200
Manganese	2800	400
Alkalinity (total as CaCO3)	250	ND (<170)

* All units as mg/Kg (dry wt.)

AMEOX® Technology Key Benefits

1) Destroys PFAS in GAC ending the PFAS cycle
2) No discharge of AMEOX fluid. Sustainably recycled
3) Low power (240V/1-ph/<50A)
4) Ambient temperature (100oF), low pressure (<80psi)
5) Carbon re-use estimate: ~7X. 4X+ to date for landfill leachate
6) Small 4’ x 12’ footprint. Portable or fixed site application
7) Flexibly accommodates range of GAC adsorber/reactor sizes

AMEOX® Full-scale GAC Processing Examples – Summary Table

Spent Carbon Source	Parameters	Untreated GAC (ng/Kg-dry)	AMEOX Treated GAC (ng/Kg-dry)	Destruction (%)	Comment
Groundwater Remediation	PFOA + PFOS	3,313,000	485,500	-85.3%	Full-scale commercial. Re-used for Landfill
	Total PFAS	3,343,780	513,250	-84.7%	Leachate Treatment
Landfill Leachate Treatment	PFOA + PFOS	7,547,000	788,400	-89.6%	Full-scale commercial. Treated 2nd time
	Total PFAS	7,722,337	810,430	-89.5%	after 2nd reuse. Original from groundwater remediation. Use #3 for Landfill Leachate
Mfg Plant Basement AFFF Fire-Fight Water,	PFOA + PFOS	254,200	86,500	-66.0%	Full-scale commercial. Re-used for Landfill
Detroit, MI	Total PFAS	271,513	93,716	-65.5%	Leachate Treatment
Landfill Leachate Treatment (Top 1/2 GAC)	PFOA + PFOS	1,624,000	ND	>99%	Full-scale Commercial. Re-used for Landfill
	Total PFAS	1,666,270	270	>99%	Leachate Treatment.
Landfill Leachate Treatment (Bottom 1/2 GAC)	PFOA + PFOS	1,624,000*	ND	>99%	
* Top+Bottom composited pre-treat	Total PFAS	1,666,270*	230	>99%	
AFFF Pit Water GAC	PFOA + PFOS	1,900,000	ND	97%	Full-scale Commercial
	Total PFAS	2,408,550	ND	97%	
State of MI Superfund GW Remediation Site.	PFOA + PFOS	22,937,500	6,841,000	-70.2%	Full-scale Pilot (2020)
Production Plated Plastics, Richland, MI	Total PFAS	23,249,398	6,995,500	-69.9%	
City of Ann Arbor, MI	PFOA + PFOS	104,448	6,800	-93.5%	Full-scale Pilot (2020)
DW Treatment Plant GAC, Ann Arbor, MI	Total PFAS	379,446	31,400	-91.7%	

NOTES:

1) GAC with PFAS destruction at >65% was suitable for re-use to treat landfill leachate for sanitary discharge. Destruction to DL not necessary for re-use.
2) Iron, calcium, aluminum, manganese and alkalinity removal data not shown
3) No physical degradation of GAC due to AMEOX processing (EPS Analytical)

Analytical data by ALS Global, Holland, MI for State of MI (EGLE/MPART) PFAS Telomere List
(see individual data slides – attached)

AMEOX® Single Unit
July 2023

AMEOX® Single Unit Systems Readiness Testing

YB Technologies, LLC

Anacortes, WA

August 2023

AMEOX – Process Control & Cost Variables:

1. GAC Quality (Coal, Coconut/Other, Re-agglomerated, Virgin, Service, etc.)
2. Water Chemistry (treated by GAC and used for AMEOX Fluid)
3. Operating Temperature (35^{o}F – 125^{o}F) and Pressure Range (atmospheric to 80-85 psi)
4. Local power rates, power intensity, frequency, and modulation
5. PFAS Concentrations/Mass of GAC per Reactor Batch
6. GAC end-use/performance objectives (Reuse Reactivation, Internment, Subsequent Processing)
7. 3-5^{+}-yr. AMEOX Equipment Life Expectancy (w/pumps @ 2-3 years with servicing)

Technology Pairing:

- **MBT Reagent System** for leachable PFAS sequestration in solid waste (soils, biosolids, sediments, misc. solids)
- **AN™ Technology** for leachate pre-treatment (TSS, heavy metals, emulsions, bacteria, various TDS, complex wastewater). Conditions leachate for GAC removal by GAC/Other media.
- **AMEOX® technology** for PFAS destruction within GAC media and subsequent GAC reuse

QUESTIONS?

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