使用 EDGE 加压流体萃取仪快速提取不同样品中的 PFAS

PFAS(全氟和多氟烷基物质)是一种广泛应用于工业生产中的人造化合物，其耐高温，防污防滑的特性使得它在不粘炊具，食品快餐盒，消防泡沫，防污织物和家具中被广泛应用。因极难在环境中降解，具有长距离迁移及生物累积性的特点，使得 PFAS 一旦进入人体，就会一直留在人体之中。PFAS 类物质的累积会引起诸多人类健康问题，如癌症、内分泌紊乱和不孕症等。因此，对他们的监测至关重要。

最近 CEM 北美实验室用 EDGE 加压流体萃取系统分别对随机购买的黄瓜、纸杯蛋糕及微波食品进行 PFAS 的提取，同时以土壤为样本进行低中高浓度的 PFAS 加标实验。

为确保实验不受 PFAS 干扰，已对 EDGE 系统中可能存在 PFAS 的材料进行了全面替换，并在测试过程中，避免使用可能含有 PFAS 的耗材及检测设备。

Table 1. PFAS Compounds Assessed, Their Respective Detection Limit, and Soak Test Results

Compound	Limit of Detection (ng/L)	EDGE System	PEEK Tubing	Polypropylene Tubing	C9 Q-Disc	G1 Q-Disc	Q-Disc Separator	Q-Matrix Hydra	Q-Cup
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	25	ND	ND	ND	ND	ND	ND	ND	ND
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	25	ND	ND	ND	ND	ND	ND	ND	ND
1H, 1H, 2H, 2H-perfluorodecane sulfonic acid (8:2 FTS)	50	ND	ND	ND	ND	ND	ND	ND	ND
1H, 1H, 2H, 2H-perfluorooctane sulfonic acid (6:2 FTS)	50	ND	ND	ND	ND	ND	ND	ND	ND
1H,1H,2H,2H-perfluorododecane sulfonic acid (10:2 FTS)	50	ND	ND	ND	ND	ND	ND	ND	ND
1H,1H,2H,2H-perfluorohexane sulfonic acid (4:2 FTS)	50	ND	ND	ND	ND	ND	ND	ND	ND
Hexafluoropropylene oxide dimer acid (GenX)	50	ND	ND	ND	ND	ND	ND	ND	ND
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	50	ND	ND	ND	ND	ND	ND	ND	ND
N-ethylperfluoro-1-octanesulfonamide (EtFOSA)	50	ND	ND	ND	ND	ND	ND	ND	ND
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	50	ND	ND	ND	ND	ND	ND	ND	ND
2-N-ethylperfluoro-1-octanesulfonamido-ethanol (EtFOSE)	50	ND	ND	ND	ND	ND	ND	ND	ND
N-methylperfluoro-1-octanesulfonamide (MeFOSA)	100	ND	ND	ND	ND	ND	ND	ND	ND
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	50	ND	ND	ND	ND	ND	ND	ND	ND
2-N-methylperfluoro-1-octanesulfonamido-ethanol (MeFOSE)	50	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1-butanesulfonic acid (PFBS)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1-decanesulfonic acid (PFDS)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1-heptanesulfonic acid (PFHpS)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1-nonanesulfonic acid (PFNS)	53	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1-octanesulfonamide (PFOSA)	50	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1-pentanesulfonic acid (PFPeS)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorohexanesulfonic acid (PFHxS)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-butanoic acid (PFBA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-decanoic acid (PFDA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-dodecanoic acid (PFDoA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-heptanoic acid (PFHpA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-hexanoic acid (PFHxA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-nonanoic acid (PFNA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-octanoic acid (PFOA)	25	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-pentanoic acid (PFPeA)	25	ND	ND	ND	ND	ND	ND	ND	ND

PFAS Detected
2-N-methylperfluoro-1-octanesulfonamido-ethanol (MeFOSE)
perfluoro-n-butanoic acid (PFBA)
perfluoro-n-hexanoic acid (PFHxA)
perfluoro-n-octanoic acid (PFOA)
perfluoro-n-pentanoic acid (PFPeA)

PFAS Detected
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)
perfluoro-1-pentanesulfonic acid (PFPeS)
perfluorohexanesulfonic acid (PFHxS)
perfluoro-n-butanoic acid (PFBA)
perfluoro-n-heptanoic acid (PFHpA)
perfluoro-n-hexanoic acid (PFHxA)
perfluoro-n-nonanoic acid (PFNA)
perfluoro-n-octanoic acid (PFOA)
perfluoro-n-pentanoic acid (PFPeA)

PFAS Detected	
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	perfluoro-n-hexanoic acid (PFHxA)
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	perfluoro-n-nonanoic acid (PFNA)
perfluoro-1-butanesulfonic acid (PFBS)	**perfluoro-n-octanoic acid (PFOA)**
perfluoro-1-decanesulfonic acid (PFDS)	perfluoro-n-pentanoic acid (PFPeA)
perfluoro-1-heptanesulfonic acid (PFHpS)	perfluoro-n-butanoic acid (PFBA)
perfluoro-1-pentanesulfonic acid (PFPeS)	perfluoro-n-decanoic acid (PFDA)
perfluorohexanesulfonic acid (PFHxS)	perfluoro-n-dodecanoic acid (PFDoA)
perfluoro-n-butanoic acid (PFBA)	perfluoro-n-heptanoic acid (PFHpA)
perfluoro-n-decanoic acid (PFDA)	perfluoro-n-tridecanoic acid (PFTrDA)
perfluoro-n-dodecanoic acid (PFDoA)	perfluoro-n-u0ecanoic acid (PFUdA)
perfluoro-n-heptanoic acid (PFHpA)	**perfluorooctanesulfonic acid (PFOS)**

Compound	Low Spike	RSD (n=3)	High Spike	RSD (n=3)
1H, 1H, 2H, 2H-perfluorodecane sulfonic acid (8:2 FTS)	83.00%	7.81%	87.00%	7.00%
1H, 1H, 2H, 2H-perfluorooctane sulfonic acid (6:2 FTS)	80.00%	3.00%	87.67%	7.09%
1H,1H,2H,2H-perfluorohexane sulfonic acid (4:2 FTS)	86.67%	10.02%	87.67%	5.13%
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	85.67%	6.66%	86.00%	5.57%
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	78.67%	1.15%	81.33%	4.16%
Perfluoro-1-butanesulfonic acid (PFBS)	78.00%	3.00%	86.00%	1.73%
Perfluoro-1-decanesulfonic acid (PFDS)	77.00%	6.56%	84.33%	0.58%
Perfluoro-1-heptanesulfonic acid (PFHpS)	81.00%	2.65%	87.00%	2.65%
Perfluoro-1-nonanesulfonic acid (PFNS)	76.00%	6.56%	84.67%	2.89%
Perfluoro-1-octanesulfonamide (PFOSA)	81.00%	8.00%	86.67%	5.03%
Perfluoro-1-pentanesulfonic acid (PFPeS)	78.00%	4.36%	86.33%	0.58%
Perfluorohexanesulfonic acid (PFHxS)	98.33%	2.89%	89.67%	3.79%
Perfluoro-n-butanoic acid (PFBA)	85.65%	4.01%	88.17%	2.20%
Perfluoro-n-decanoic acid (PFDA)	101.33%	7.51%	93.33%	2.89%
Perfluoro-n-dodecanoic acid (PFDoA)	79.67%	7.37%	79.33%	2.08%
Perfluoro-n-heptanoic acid (PFHpA)	90.67%	9.02%	81.67%	3.21%
Perfluoro-n-hexanoic acid (PFHxA)	100.67%	9.02%	91.08%	6.64%
Perfluoro-n-nonanoic acid (PFNA)	96.33%	3.21%	92.67%	2.52%
Perfluoro-n-octanoic acid (PFOA)	82.77%	3.87%	85.53%	2.25%
Perfluoro-n-pentanoic acid (PFPeA)	79.50%	0.71%	85.67%	4.04%
Perfluoro-n-tetradecanoic acid (PFTeDA)	86.67%	4.73%	88.67%	1.15%
Perfluoro-n-tridecanoic acid (PFTrDA)	63.00%	3.46%	68.33%	3.51%
Perfluoro-n-uOecanoic acid (PFUdA)	76.33%	1.53%	79.67%	3.51%
Perfluorooctanesulfonic acid (PFOS)	84.00%	4.00%	79.60%	0.53%

EDGE 对低、中、高浓度加标的土壤样品的提取，单样品提取时间小于 10 分钟，并可获得理想回收率及 RSD 值，同时，在黄瓜、纸杯蛋糕、微波食品中均检出 PFAS 物质。