ADSORPTON OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) ON FLUORO-SORB® ADSORBENT

EFFECT OF CO-CONTAMINANTS AND WATER CHEMISTRY

Background:

Dr. Jinxia Liu, McGill University, studied the performance of FLUORO-SORB® 200 Adsorbent for removing per- and polyfluoroalkyl substances (PFAS) from an aqueous film-forming foam (AFFF) contaminated groundwater. Batch adsorption experiments demonstrated that Fluoro-sorb adsorbent is highly effective at removing a variety of PFAS compounds from a contaminated groundwater via adsorption. The influence of co-contaminants and water chemistry on performance was also investigated. Organic co-contaminants and varying water chemistry did not significantly affect PFAS removal. The effect of diesel, a mixture of benzene, toluene, ethylbenzene, and xylene (BTEX), trichloroethene (TCE), and 1,4-dioxane, as well as varying levels natural organic matter (NOM) and common groundwater cations were tested.

The AFFF-contaminated groundwater, which was collected near a firefighting training area at a former airfield, contained total PFAS of 64.9 ±1.0 µg/L, with PFOA (5.99 ±0.11 µg/L) and PFOS (14.2 ±0.3 µg/L) present. Chemical oxygen demand (COD) was 7.9 mg/L and total organic carbon (TOC) was 2.4 mg/L. Other non-PFAS contaminants detected were diesel (C 10 -C 28, 0.43 mg/L) and acetone (8.3 mg/L). Mineral concentrations of calcium (50 mg/L), magnesium (6.6 mg/L), sodium (2.6 mg/L) and potassium (0.77 mg/L) were measured. The initial pH value of the groundwater was pH 8.

Batch adsorption experiments were carried out by mixing the AFFF-impacted groundwater (400 ml) and 40 mg of media for 168 hours in 500 mL high-density polyethylene (HDPE) bottles. Samples for PFAS analysis were collected at time intervals, and equilibrium was considered to be at 168 hours. The effect of co-contaminants and water chemistry was also examined by the addition of diesel, BTEX, TCE, 1,4-dioxane, NOM, $CaCl_2$ and NaCl to the 400 mL of groundwater at environmentally relevant concentrations. Experiments were run in triplicates, and the results presented are mean values.

Results:

Diesel (C10- C28) at the low level of 1.0 mg/L either mildly reduced the removal of PFAS or had no impact, as shown in Figure 1. However, at 100 mg/L, diesel slightly improved the removal of PFAS, including PFOS, PFOA, and the short-chain PFAS compounds. Figure 2 shows that the PFAS removal amounts in the presence of low (0.01 mg/L) and high (1.0 mg/L) concentrations of BTEX, TCE, and 1,4-dioxane were almost identical, suggesting no or minimal impact. Figure 3 shows that 1.0 mg/L of NOM did not impact adsorption, but at 100 mg/L of NOM, removal was reduced by up to 30%. Figure 4 shows that low- and high-level enhancement of the groundwater with cationic calcium and magnesium did not make any difference in the amount of PFAS adsorbed by Fluoro-sorb adsorbent.

Conclusions:

The performance of Fluoro-sorb adsorbent is unlikely to be significantly altered by co-contaminants, low levels of NOM, water hardness, or ionic strength. However, higher levels of NOM (100 mg/L) can reduce performance by up to 30%.

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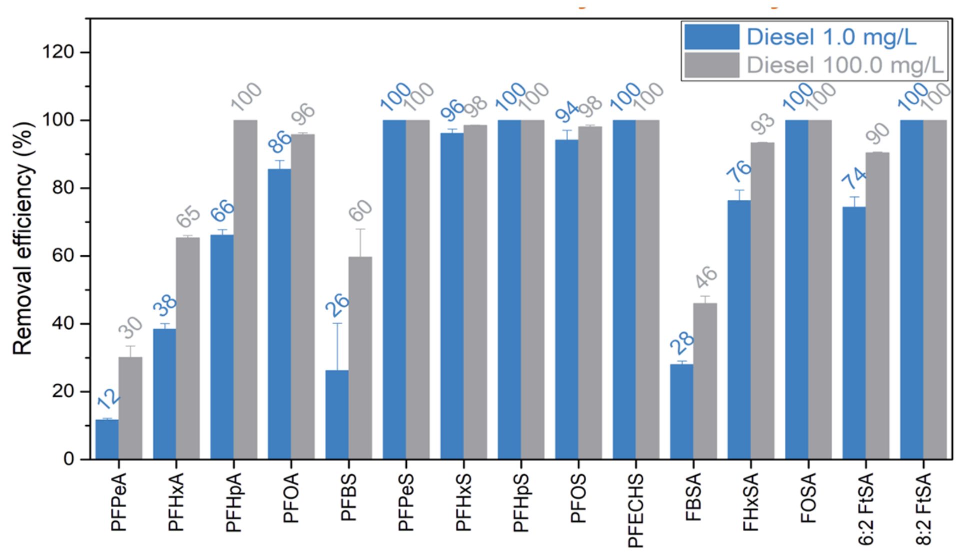

Figure 1: Effect of 1.0 mg/L and 100 mg/L of diesel on the adsorption of PFAS by FLUORO-SORB® 200 Adsorbent.

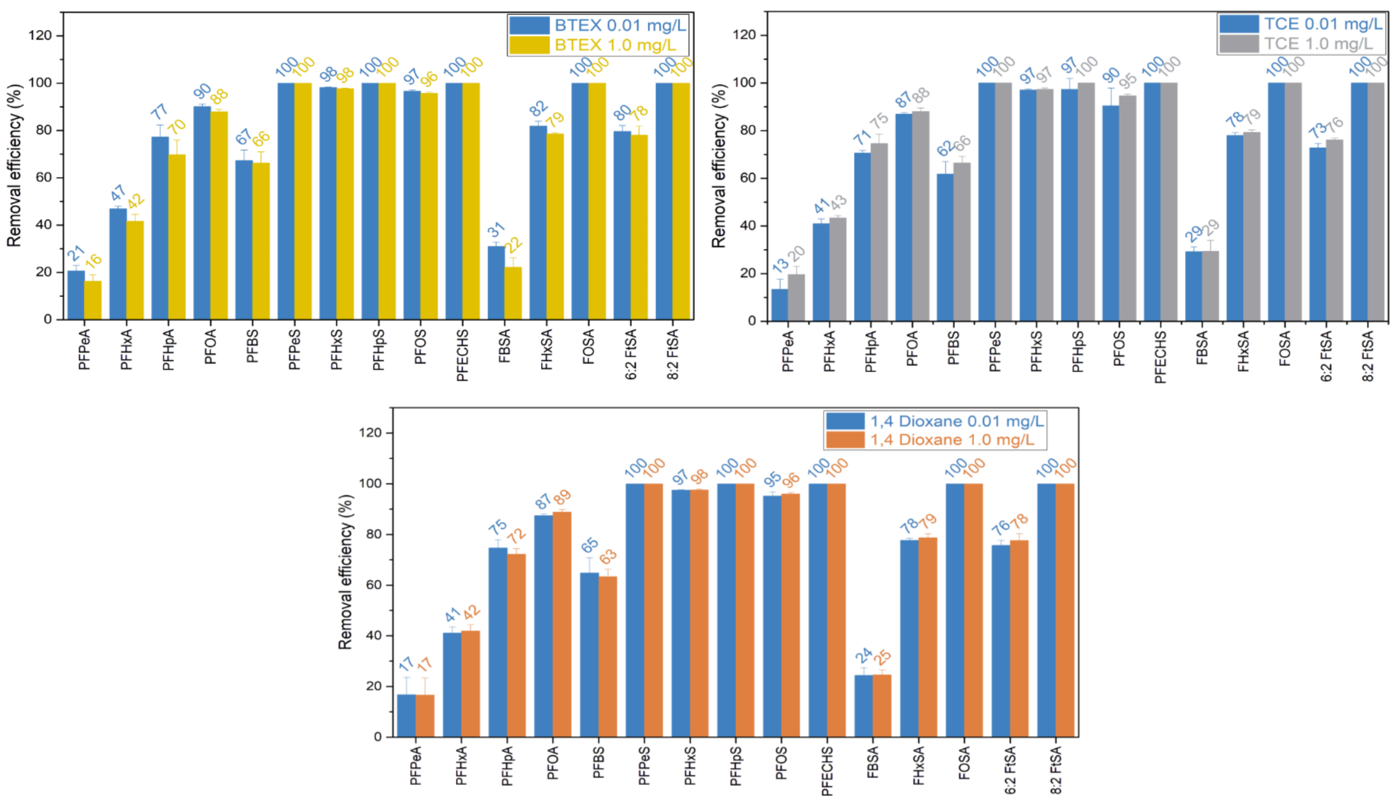

Figure 2: Effect of 0.01 mg/L and 1.0 mg/L of BTEX, TCE, and 1,4 Dioxane on the adsorption of PFAS by FLUORO-SORB® 200 Adsorbent.

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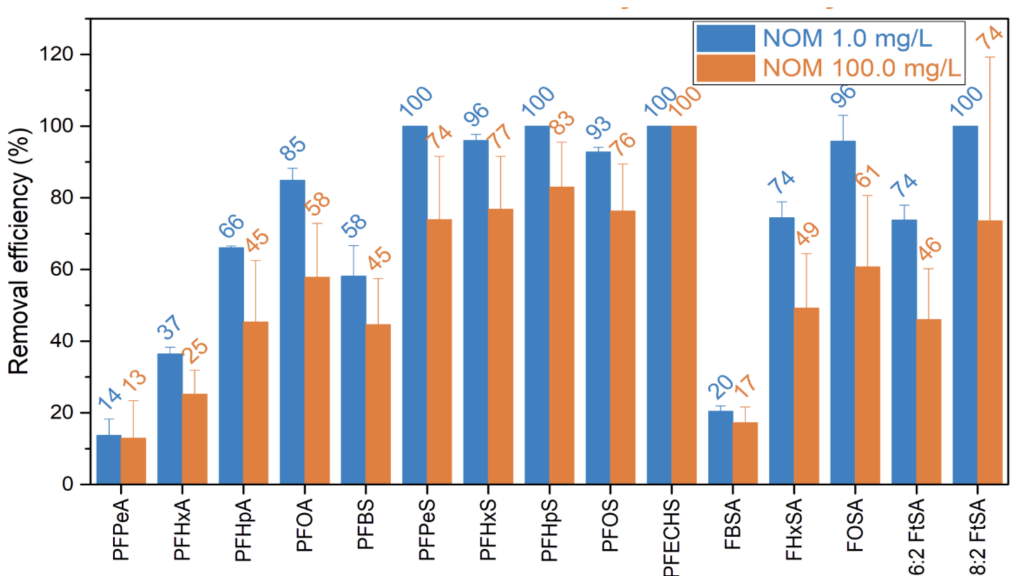

Figure 3: Effect of 1.0 mg/L and 100 mg/L of NOM on the adsorption of PFAS by FLUORO-SORB® 200 Adsorbent.

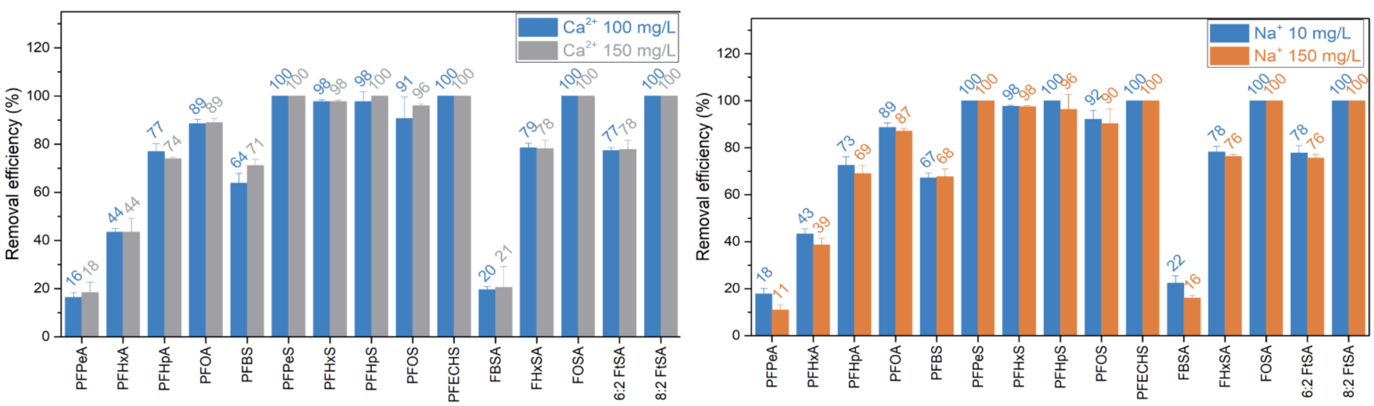

Figure 4: Effect of various amounts of cationic calcium and sodium on the adsorption of PFAS by FLUORO-SORB® 200 Adsorbent.

__Reference__: Yan, B., Munoz, G., Sauvé, S., and Liu, J. (2020) “Molecular mechanisms of per- and polyfluoroalkyl substances on a modified clay: a combined experimental and molecular simulation”, __Water Research__, 184, 116166.

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