

Assessment of pharmaceutical and personal Care Products (PPCPs) in surface and drinking waters of Northeast Ohio

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ABSTRACT: Pharmaceuticals and personal care products (PPCPs) are unintentionally discharged into the environment from domestic, agricultural, and industrial sources and end up in drinking water treatment plants (DWTPs). However, very little is known about the effectiveness of these plants in PPCP removal. The purpose of this study was to compare PPCP concentrations in the source and finished water in four DWTPs of Northeastern Ohio. Source and drinking water samples were obtained from the plants monthly from May until September in 2018 and 2019. PPCPs were quantified after solid-phase extraction using HPLC-MS technique. The antibiotic sulfamethoxazole was detected in two DWTPs. Estradiol and caffeine were detected in all samples for every month in the DWTPs. From this study, we concluded that the selected DWTPs were effective in reducing and in some cases removing the PPCPs from the finished water samples

Introduction

- Pharmaceutical and personal care products (PPCPs) are one group of contaminants of emerging concern that includes antibiotics, steroids, prescription drugs, sunscreen, shampoo, and flame retardants
- PPCPs are released from domestic, agricultural, and industrial sources and end up in drinking water treatment plants (DWTPs).
- Currently PPCP monitoring is not mandatory according to state or federal regulations leaving us with very limited information on their occurrence or removal efficiencies from the DWTPs.

Purpose

To determine the efficiency of drinking water treatment plants (DWTPs) of northeast Ohio in removing or reducing PPCP concentrations in the finished/tap water



A view of DWTP 2 in Northeast Stark County in Ohio

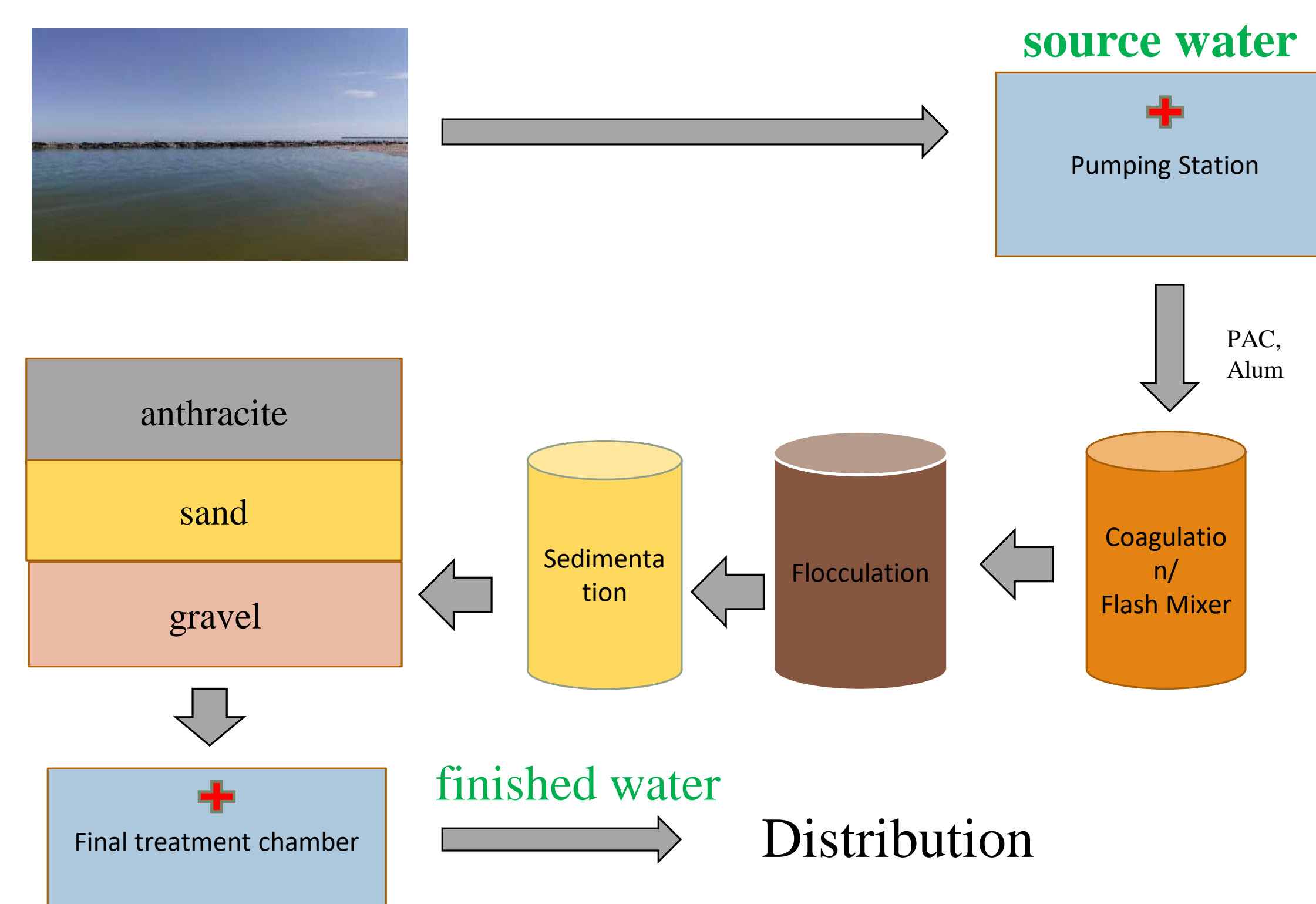
Methods

- Water samples were collected from source and finished waters in four DWTPs from May until September for the years 2018 and 2019.
- Samples were filtered using a 0.2 μm glass microfiber filter (Whatman) and stored in -20°C .
- Samples were acidified with hydrochloric acid and treated with EDTA.
- The samples were concentrated by solid phase extraction (SPE) using hydrophilic lipophilic cartridge (HLB).
- Standards of the selected PPCPs were analyzed to obtain a method detection limit (MDL) and a calibration line for sample quantification.
- Samples were then analyzed using high performance liquid chromatography- mass spectrometry (HPLC-MS) to detect PPCPs in the water samples.

Sampling sites

site	powdered activated carbon	ultrafiltration	reverse osmosis	Sand filters	UV filtration
DWTP 1	+			+	
DWTP 2	+			+	+
DWTP 3	+			+	
DWTP 4	+	+	+	+	

Treatment process



The red signs indicate the locations from where the samples were derived

Results

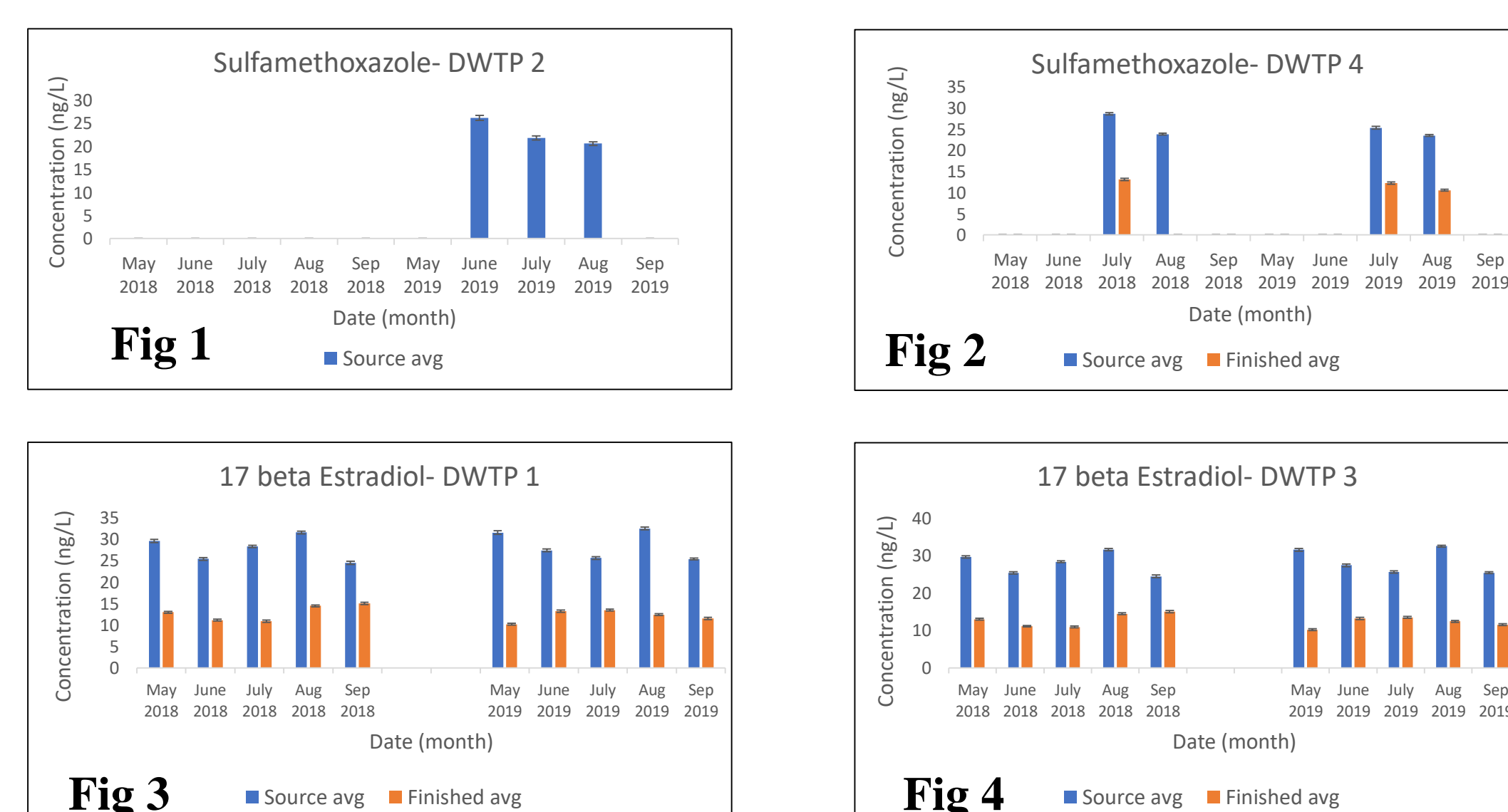


Fig 1 depicts sulfamethoxazole concentration detected in source water in DWTP 2 whereas Fig 2 depicts it in both source and finished waters in DWTP 4. Fig 3 and 4 exhibits estradiol in source and finished waters in DWTP 1 and 3.

Results

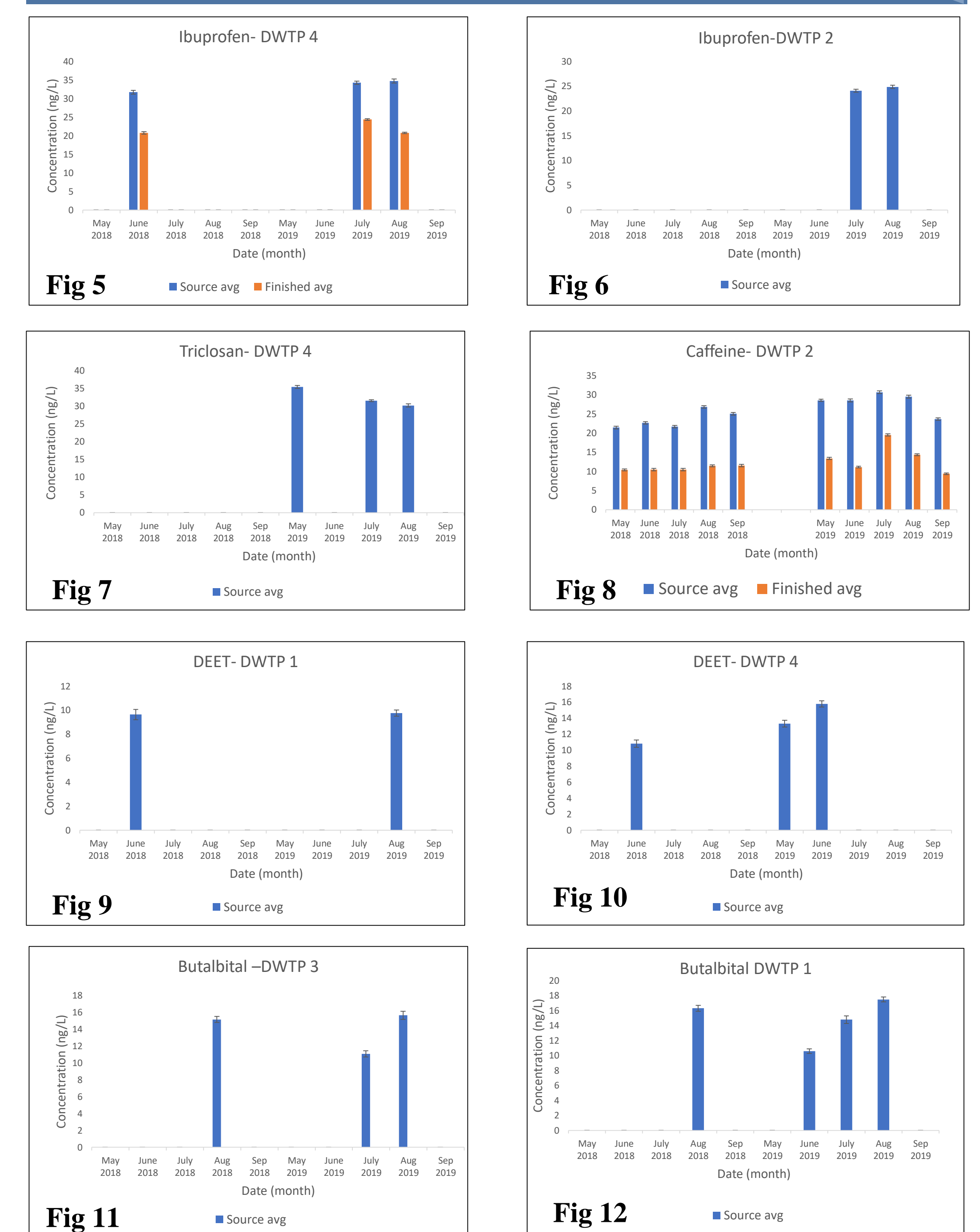


Fig 5 and 6 depicts ibuprofen concentrations in two of the four DWTPs. Fig 7 indicate triclosan which was only found in DWTP 4. Fig 8 show caffeine concentration in DWTP 1. Patterns on the other treatment plants are similar. Figures not shown. Fig 9 and 10 depict the presence of DEET only in source water in DWTP 1 and 4 Fig 11 depicts butalbital concentrations detected only in source water in DWTP 1 and 3.

Conclusion

- Sulfamethoxazole was detected in two treatment sites. The DWTP 2 depicted complete removal of sulfamethoxazole whereas DWTP 4 showed a 55% removal from finished water. On the other hand DWTP 2 exhibited complete removal of ibuprofen from the finished water.
- This indicates that the filtration in DWTP 2 are more efficient in removing these PPCP compounds.
- Caffeine and 17 beta estradiol were detected in all four DWTP samples for both 2018 and 2019. The DWTPs indicated a reduction between 30-68% in the finished waters.
- DWTPs 1,3 and 4 indicated high efficiency in removing butalbital and DEET completely (100% removal) from the finished waters.