12th Eastern European Young Water Professionals Conference

the international water association

Book of Abstracts

WATER RESEARCH AND INNOVATIONS IN DIGITAL ERA

31 March -2 April 2021, Riga, Latvia

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Are Side-Stream Loads of Pharmaceutical Compounds Important for the Large-Scale Wastewater Treatment Plants?

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INTRODUCTION

The presence of pharmaceutical compounds in the environment has become a serious global concern since they pose a direct or indirect threat for almost all aquatic species, animals and even people (Lee *et al*., 2019). Wastewater treatment plants (WWTPs) are considered as the one of the most important point sources with regard to the discharge of pharmaceutical compounds into receiving environments. Since most of the existing conventional WWTPs cannot completely remove pharmaceuticals (Tran *et al*., 2018), determining the individual and total pharmaceutical loads discharged from WWTPs into receiving environments is crucial for evaluating their potential adverse effects on all living creatures.

Although there are numerous studies performed about occurrence, distribution and removal of pharmaceuticals in WWTPs found in different geographical regions, there are very few researches investigating the side-stream contribution of these compounds to total loads in WWTPs. In this study, the effect of side-streams of three pharmaceutical compounds belonging to different therapeutic groups on total loads were investigated in order to determine their behavior patterns both in sludge thickener and sludge dewatering units found in an advanced biological WWTP. Within this scope, diclofenac (DCF) from the group of nonsteroidal anti-inflammatory drugs, carbamazepine (CBZ) from the group of anticonvulsants and ciprofloxacin (CIP) from the group of antibiotics were investigated. Besides, the increase and decrease in the concentration values of the each investigated pharmaceutical compounds in the side streams returning to the beginning of the plant were evaluated based on the concentration values determined in the raw wastewater. Finally, within the scope of the findings, it was evaluated whether the side streams were a serious problem for a large-scale WWTP by calculating the extra pharmaceutical load percentages caused by the side-streams originating from both in sludge thickening and the sludge dewatering (decanter) units.

MATERIALS AND METHODS

Sampling campaigns were performed in the months of June and August of the summer season of the year of 2019. The study was performed in a large-scale urban WWTP which is operated as biological 4 stage Bardenpho process found in the city of Konya, Turkey. Wastewater samples were collected from the raw wastewater, sludge thickening and sludge dewatering units. Although the capacity of the WWTP is 200 000 m^3/d, an average of 165 000 m^3 of wastewater was treated daily at the WWTP during the sampling months. Besides, flows of side-stream originated from the sludge thickening and sludge dewatering units were measured as about 5500 m^3/d and 1500 m^3/d, respectively in the sampling campaigns. Hydraulic retention times of wastewater treatment processes were also taken into consideration in the sampling campaigns while sampling.

Collected wastewater samples were firstly filtered through 0.45 µm polytetrafluoroethylene (PTFE) filters. After solid-phase extraction (SPE) method was performed, wastewater samples were analyzed by liquid chromatography mass spectrometry / mass spectrometry (LC-MS/MS).

RESULTS AND CONCLUSION

Concentrations of three pharmaceutical in raw wastewater and side-steams originated from both sludge thickener and sludge dewatering units in the sampling campaigns are given in Fig. 1. While very similar behaviors were determined for CIP in the side-streams for the different sampling months, small behavioral differences were found for DCF and CBZ. In general, the concentrations determined in the side streams for both DCF and CBZ were found to be very close to the raw wastewater concentrations. In addition, the highest concentration values for CBZ were detected in sludge dewatering leachate in both sampling months. However, the behavior of CIP was found to be quite different from other investigated compounds. While the concentration of CIP detected in raw wastewater decreased by about half in sludge thickening leachate, it increased considerably in the sludge dewatering unit leachate up to 3 times of the concentration values in raw wastewater.

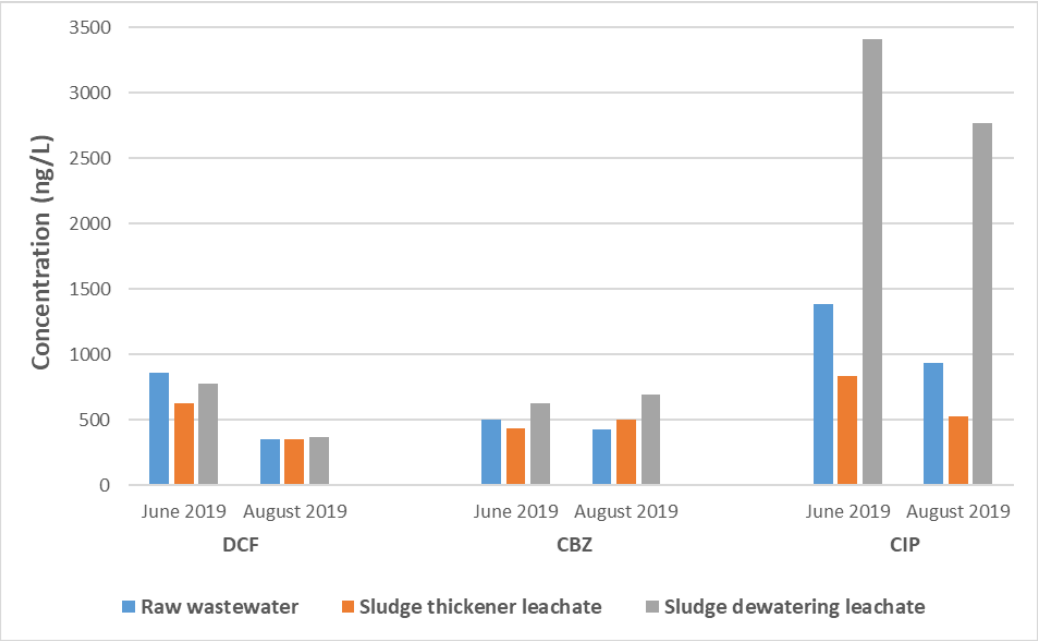

Figure 1. Concentrations of pharmaceutical compounds in raw wastewater and side-streams.

Considering the flows of side-stream that occurred during the sampling campaigns, contribution of the side-stream loads caused by the sludge thickener and sludge dewatering units to total pharmaceutical loads ranged between 1.87–3.91 % and 0.82–2.69 %, respectively. The total side-stream contributions to total load were calculated in the ranges of 3.25–4.26 %, 4.01–5.40 % and 4.27–4.56 % for DCF, CBZ and CIP, respectively. As a result, it has been determined that the extra pharmaceutical loads caused by side-streams in WWTPs can be roughly calculated over the raw wastewater concentrations of pharmaceutical compounds and the generated side-stream flows in WWTPs. Therefore, it can be said that extra pharmaceutical loads caused by side streams are a greater drawback for WWTPs than estimated.

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