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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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Removal and Yearly Variability of Selected Non-Steroidal Anti-Inflammatory Drugs and Antibiotics in a Large-Scale Municipal Wastewater Treatment Plant

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INTRODUCTION

Due to their extremely consumption all over the world, pharmaceuticals are frequently detected in different water bodies, sediments, agricultural lands, plants, vegetables and even aquatic species (Ben *et al*., 2019; Tran *et al*., 2018). Presence of these emerging compounds with threatening concentrations almost in all different environmental matrices are mainly associated with wastewater treatment plants (WWTPs). Because, existing conventional WWTPs cannot act as a full barrier for complete elimination of pharmaceuticals similar to other micropollutant groups. Consequently, many of these pharmaceuticals pass into receiving water bodies along with discharged treated wastewaters with their known or unknown adverse effects both for ecosystems and human.

Nonsteroidal anti-inflammatory drugs (NSAIDs) and antibiotics are the most consumed two important sub-groups of pharmaceuticals for the different purposes both in the field of human and veterinary medicine (Moreno-González *et al*., 2014). Primary objective of this study was to determine the occurrence levels and fate of six pharmaceuticals belong to the groups of NSAID and antibiotic in a conventional urban WWTP in consecutive years. Within this scope, acetaminophen and diclofenac in the group of NSAID and ciprofloxacin, sulfamethoxazole, trimethoprim and erythromycin in the antibiotic group were investigated. Secondly, the annual changes of each studied pharmaceuticals in the same WWTP were compared in terms of both occurrence concentrations and removal efficiencies. Finally, the possible reasons of significant differences observed yearly regarding to the total removals of certain compounds were evaluated.

MATERIALS AND METHODS

The study was performed in Konya WWTP which was designed to treat approximately 200 000 m^3/d wastewater. Has an activated sludge treatment system involving biological 4 stage Bardenpho process, Konya WWTP serves approximately 1.3 million population in the city. All domestic, industrial and hospital wastewater of the city are directed to Konya WWTP through the combined sewerage system.

Sampling campaigns were carried out in the September months of 2018 and 2019 years. Wastewater samples were collected as 2 h composite samples from the raw wastewater before the screens and effluents of both primary and secondary clarifiers by a 1 L amber bottles with teflon-lined caps. Hydraulic retention times of the treatment units were also taken into account during the sampling campaigns. In both sampling years, collected wastewater samples were filtered through 0.45 µm polytetrafluoroethylene (PTFE) filters. While direct injection method was used in the first sampling year, a solid-phase extraction (SPE) method was applied in the second sampling year. All analyses were performed by liquid chromatography mass spectrometry/mass spectrometry (LC-MS/MS) in both sampling campaigns.

RESULTS AND CONCLUSION

Occurrence concentrations and behaviors of two NSAIDs and four antibiotics in the wastewater line of Konya WWTP were determined in the same months of consecutive years. Within this scope, it was aimed to minimize the seasonal effects to evaluate the fate of selected compounds. The results obtained in two sampling campaigns were given in Table 1.

Table 1. Fate and removal of pharmaceuticals throughout the wastewater line of Konya WWTP.

Pharmaceuticals ng/L	September of 2018				September of 2019			
	R. W.	P. C.	S. C.	Removal, %	R. W.	P. C.	S. C.	Removal, %
NSAIDs								
Acetaminophen	2324.5	932.3	<LOQ	>95.7	25842	364	<LOQ	>99.9
Diclofenac	827.6	744.6	528.1	36.2	36	172	75	–108.3
Antibiotics								
Ciprofloxacin	895.4	1258.8	<LOQ	>88.8	2639	3461	153	>94.2
Sulfamethoxazole	95.8	162.9	223.6	–133.4	313	197	146	53.4
Trimethoprim	<LOQ	<LOQ	<LOQ	–	20	<LOQ	37	–85.0
Erythromycin	<LOQ	<LOQ	<LOQ	–	<LOQ	<LOQ	<LOQ	–

* R. W. (raw wastewater); P. C. (primary clarifier); S. C. (secondary clarifier); LOQ (limit of quantification).
* While LOQ was 50 ppt for the first sampling campaign, the value of LOQ was 10 ppt for the second sampling campaign.

In general, occurrence concentrations of all pharmaceuticals in raw wastewater increased except the diclofenac in the year of 2019 compared to 2018. Substantial increase was observed especially for acetaminophen. Erythromycin was not detected in any of the sampling points during both sampling campaigns. Besides the occurrence concentrations, significant differences were detected in the behavior patterns of some compounds within two years. While diclofenac was treated to some extent as positive in 2018, serious negative removal rate was seen in 2019. Another example was that while negative removal efficiency was obtained for sulfamethoxazole in 2018, moderate positive removal was achieved in 2019. Although the removal rates between the treatment units were different between the sampling campaigns, both behavior patterns and total removal efficiencies of acetaminophen and ciprofloxacin were found as quite similar for the year of 2018 and 2019. As a result, although the studies were conducted in the same WWTP in the same period, it was found out that it is very difficult to make accurate predictions and generalizations about the fate and removal of pharmaceuticals.

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