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EVALUATION OF SURFACTANT REMOVAL EFFICIENCY IN DIFFERENT MUNICIPAL WWTP'S IN ROMANIA

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Introduction

The population increase and the continuous developing of anthropogenic activities have generated toxic chemical compounds with harmful potential for the environment. In addition, the recent SARS COVID-19 crisis of 2020 spiked in Romania the sales of the cleaning and household products up to 461% compared to last year, same period of time), meaning an increase of inorganic and organic chemical compounds, including the surfactants, in sewage systems. The oldest and the most common type of surfactant used in cleaning detergents and personal care products is the anionic surfactant.

Usually, used surfactants are disposed to sewage treatment plants, where the biodegradation processes and adsorption on sludge particles remove these chemicals from wastewaters. The extent of removal depends on the chemical structure of the surfactant molecule and on the operating conditions of the wastewater treatment plants (WWTP's). The accumulation of surfactants can cause malfunction of WWTP's by affecting several treatment processes such as the oxygen diffusion, foaming, biodegradation of organic compounds. and denitrification of ammonium nitrogen as well as a negative influence on the structure of flocks in the activated sludge.

This paper presents results focused on operational efficiency of municipal WWTP's in terms of anionic surfactants removal.

Materials and methods

Wastewater samples were collected from the influent and effluent of the municipal WWTP's located in different cities of Romania (Iasi, Galati, Bucharest, Targoviste, Cluj, Ramincu Valcea,), in two different seasons (spring and summer 2020). The concentration of anionic surfactants from the samples was analyzed by spectrophotometric method based on methylene blue active substance indicator measuring (MBAS), according to the Romanian standard (SR EN 903:2003). Briefly, the surfactant was extracted into an organic phase (chloroform, 99.99% assay, Carol Erba, Spain) and it was spectrometrically measurement at a wavelength of λ=650 nm due to an indicator color (methylene blue- Merck, Darmstad, Germany).

The calibration curve was made using as etalon methyl ester of dodecyl benzene sulfonic acid (99% purity, Merck, Darmstad, Germany).

The equipment used for analytical detection was a spectrophotometer Specord BU 205 (Analytic Jena, Germany).

Results and Conclusions

The treatment process takes place in a municipal wastewater treatment plant (WWTP) from Romania may include primary treatment to remove solid material by mechanical and physical-chemical means and a secondary treatment to digest dissolved and suspended organic material as well as nutrients of nitrogen and phosphorus by biological means with activated sludge and secondary settling.

Nitrogen is removed through the biological oxidation of nitrogen from ammonia to nitrate (nitrification in aerobic conditions), followed by the reduction of nitrate to nitrogen gas (denitrification in anoxic conditions).

The reduction of anionic surfactants content was investigated by measuring their concentrations in the influents and effluents of studied municipal WWTP's plants (Table 1).

Table 1. Concentration and removal efficiency of anionic surfactants in WWTP

Municipal WWTPs	Period of analysis	Anionic surfactants		
		Influent (mg/L)	Effluent (mg/L)	Removal efficiency (%)
Iasi	Spring	0.49	<0.1	80
	Summer	0.72	0.26	64
Galati	Spring	0.69	<0.1	86
	Summer	1.86	0.33	82
Bucharest	Spring	1.85	<0.1	95
	Summer	3.60	0.19	95
Targoviste	Spring	1.65	<0.1	94
	Summer	1.44	<0.1	93
Cluj	Spring	1.42	<0.1	93
	Summer	1.99	<0.1	95

The concentration of anionic surfactants in the influents varied from 0.49mg/L to 3.60 mg/L (average 1.52 mg/L), while the concentration in the effluents were generally below the limit of quantification of the analytical method (<0.1), with several exceptions (Iasi, summer, 0.26 mg/L; Galati, summer, 0.33 mg/L and Bucharest, summer, 0.19 mg/L) (table 1).

During Summer the concentration of anionic surfactants had an increase related to Spring (table 1). That can be linked to the actual situation of pandemic SARS COVID-19 crisis and overuse of disinfectants and cleaning products and also the intensive washing procedures during this season.

The monitoring study regarding the reduction rate of anionic surfactants indicated that their removal efficiency is relatively high, exceeded 80%, with one exception, registered in July at the WWTP of Iasi municipality (64%).

The legal regulations regarding the concentration of surface active compounds (anionic) are addressed in the Government Decision no. 352/2005 (norms regarding wastewaters discharge conditions in WWTPs and the conditions of wastewater discharge in the aquatic environment): less than 25 mg/L in the WWTP influent and less than 0.5 mg/L in the WWTP effluent. The obtained results of our study pointing the efficient removal of anionic surfactants during the biodegradation process realized within municipal WWTP's from Romania and the limit values for their disposal in natural receptors are fully respected.