Preliminary Studies on the Possibility of the Use of Single-Species Stands Biosorption for Municipal Wastewater Treatment

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Introduction. The key task of municipal sewage treatment plants is to change the composition and properties of the plant, so that after passing through the technological process of purification, waste water discharged into surface waters does not represent a danger to the environment, and in particular human health. In Poland, the process of municipal wastewater treatment is implemented in 3288 objects. However, some contaminants such as. Trace metals, low value of the concentration of dissolved oxygen in the aeration, low pH or low sludge load of nutrients have a negative effect on the process of nitrification and denitrification (Mazurkiewicz 2012). Verification of the proper operation of technology and taking place in it of the biological and chemical reactions requires continuous quality control of treated wastewater and the quality of waters which are specified by the Regulation of the Minister of Environment of 18 November 2014. Literature data show that macrophytes can be used for monitoring and removal of metals from wastewater and water. These plants have a high ability to accumulate metals. The speed and the amount of active metal depends, among others on the solids content of mineral and organic waste. The metal content of macrophytes exceeds their content in the surrounding aqueous medium many times over. Due to their structure these plants may collect nutrients and contaminants through the root system, leaves, or both ways. A wide range of variation in metal content of macrophytes is due to the biology and ecology of individual species. The plants are organized, their physiological barriers are less developed and absorption of the metals takes place in a passive manner (Polechońska and Samecka-Cymerman 2015, Kastratović et al. 2014; Krems et al. 2013; Gałczyńska and Bednarz 2012). The aim of the study was to determine the level of pollution carried by municipal sewage, the calculation of the efficiency of their treatment in mechanical-biological treatment plant in Gryfino and to examine the possibility of accumulation of selected trace metals by varietal position biosorption of Hydrocharis morsusranae and Ceratophyllum demersum.

Results. The efficiency of wastewater in municipal sewage treatment plant in Gryfino is high, evidenced by, among others the average percent reduction in the years $2011 \div 2015$, which amounts to 98.9% for BOD₅, COD 97.4%, 98.0% suspension, 89.6% total nitrogen, total phosphorus 96.4% (Table 1). The contents of trace metals in treated wastewater does not exceed the limit values according to the Regulation of the Minister of Environment of 22 October 2014. Despite the low content of trace metals in waste water macrophytes accumulated a large amount of metal. Both *Hydrocharis morsus-ranae* and *Ceratophyllum demersum* the highest rate of accumulation was reached in the case of Mn (Table 2).

Conclusions. The effectiveness of the sewage treatment plant in Gryfino is much higher than the limit values specified in the Regulation of the Minister of Environment of 18 November 2014. The *Hydrocharis morsus-ranae* and *Ceratophyllum demersum* show the ability to hyperaccumulate Cu from the treated waste water, which confirms the advantage of both types of plants for cleaning the waste water treatment.

Indicator of pollution	Average value		Limit value the specified by		
	Raw sewage	Effluent	Regulation of the Minister of Environment of 18 November 2014	Efficiency	
BOD ₅	549,8	6,1	15,0 mg O_2 dm ⁻³	98,9%	
COD	1087,0	40,0	$125,0 \text{ mg}^{-3}$	97,4%	
Suspension	590,2	11,9	35,0 mg ⁻ dm ⁻³	98,0%	
Total nitrogen	80,6	9,3	15,0 mg N_{og} dm ⁻³	89,6%	
Total phosphorus	15,7	0,6	2,0 mg $P_{og.}$ dm ⁻³	96,4%	

Table 1. Characteristics of the composition of the wastewater in the years $2011 \div 2015$.

 Table 2. The content of the investigated metals in samples of treated sewage, tissues Hydrocharis morsus-ranae and Ceratophyllum demersum and bioaccumulation factor.

Metal	Effluent metal	Hydrocharis mor	sus-ranae	Ceratophyllum demersum	
	content mg dm ⁻³	Metal content mg kg ⁻¹ s. m.	BCF	Metal content mg kg ⁻¹ s. m.	BCF
Cu	0,007	35,7	5334	52,3	7804
Fe	0,305	10508	34435	14159	46400
Mn	0,017	921	53707	1785	104084
Zn	0,015	279	18447	255	16856
Pb	0,001	4,23	4972	4,88	5743
Mg	12,7	2172	171	2972	234
Na	171	8245	48	1478	9
Са	38,1	3528	93	6279	165

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