Characterization of ZW-1 ultrafiltration membrane and its application for direct municipal wastewater treatment

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INTRODUCTION

In recent times when the population faces severe water shortages, any available wastewater source should be treated with adequate technology for reuse and ultimately to protect the aquatic environment. In this sense, an enormous amount of municipal wastewater, which is most often biologically processed, should also be membrane processed. The aim of this work was to examine the efficiency of low pressure membrane process of ultrafiltration (UF) for the purification of characterized municipal wastewater. ZeeWeed-1 (ZW-1) hollow fiber ultrafiltration membrane was characterized with polyethylene glycol (PEG) and polyethylene oxide (PEO) at different permeate fluxes and afterword it was used to treat municipal wastewater.

MATERIALS AND METHODS

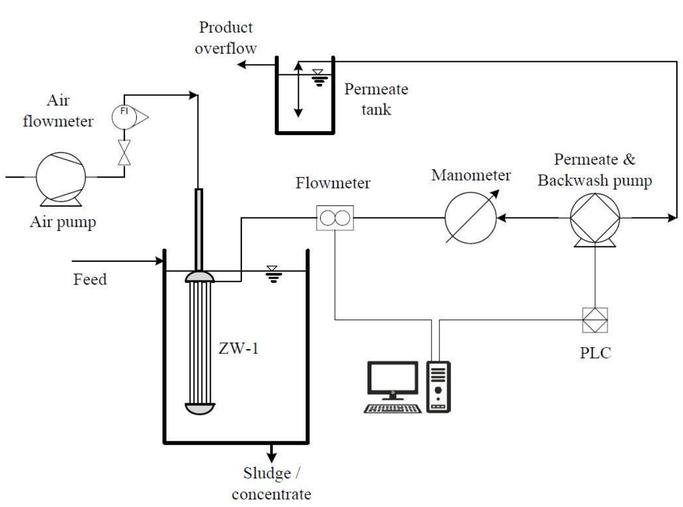
ZW-1 (GE Water & Process Technologies, Hungary) hollow fiber ultrafiltration module (0.046 m^2)

The membrane was characterized with 250 mg L^{-1} solutions of PEG, (35 kDa) and PEO, (100, 300, and 600 kDa) at different permeate fluxes (10, 20, and 40 L m^{-2} h^{-1}) and pH 5, 7, and 9.

The raw municipal wastewater was characterized before and after UF treatment by the following parameters:

turbidity, pH, conductivity, chemical oxidation demand (COD), total carbon (TC), inorganic carbon (IC), dissolved organic carbon (DOC), and content of cations (NH_4^+, Na^+, K^+, Ca^{2+}, and Mg^{2+}) and anions (SO_4^{2-}, Cl^-, NO_2^- and NO_3^-).

Laboratory set-up



RESULTS

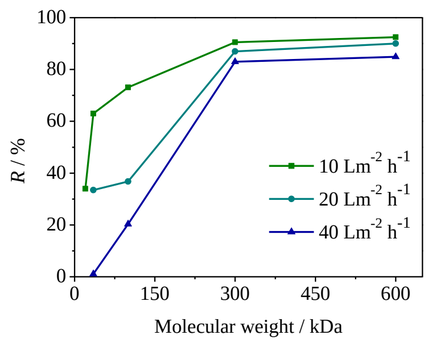


Figure 2. Change in retention (*R*) with molecular weight (pH 7).

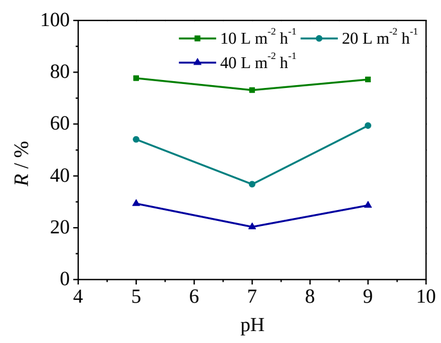


Figure 3. Change in retention at different pH and flux (100 kDa).

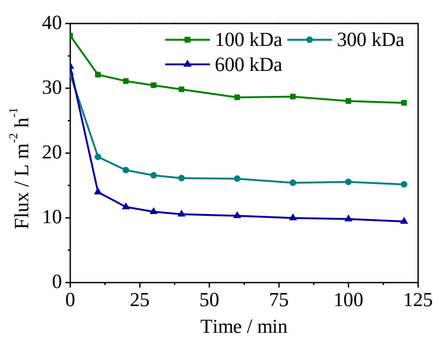


Figure 4. Flux decline for different PEO (pH 5).

Table 1. The characteristics of raw municipal wastewater and permeates after investigated permeate fluxes (10, 20 and 40 m^{-2} h^{-1}).

Parameter	Units	Feed	Permeate (10 L m^{-2} h^{-1})	Permeate (20 L m^{-2} h^{-1})	Permeate (40 L m^{-2} h^{-1})
pH	-	7.46	7.85	7,56	7,68
Conductivity	µS cm^{-1}	879	830	845	845
Turbidity	NTU	33.10	0.18	0,05	0,07
COD	mg O_2 L^{-1}	130.0	32.4	33,2	30,0
TC	mg L^{-1}	113.0	100.8	106,5	108,9
IC	mg L^{-1}	81.86	73.84	81,40	81,42
DOC	mg L^{-1}	31.14	26.96	25,10	27,48
NH_4^+	mg L^{-1}	15.40	14.32	15.76	15.66
Na^+	mg L^{-1}	32.05	33.53	31.53	31.44
K^+	mg L^{-1}	10.23	33.53	31.53	31.44
Mg_2^+	mg L^{-1}	19.74	17.81	9.54	8.90
Ca_2^+	mg L^{-1}	88.05	90.72	86.62	86.38
Cl^-	mg L^{-1}	28.98	34.74	28.29	28.54
SO_4^{2-}	mg L^{-1}	3.12	2.88	3.14	3.20
NO_3^-	mg L^{-1}	<1	<1	<1	<1
NO_2^-	mg L^{-1}	<1	<1	<1	<1

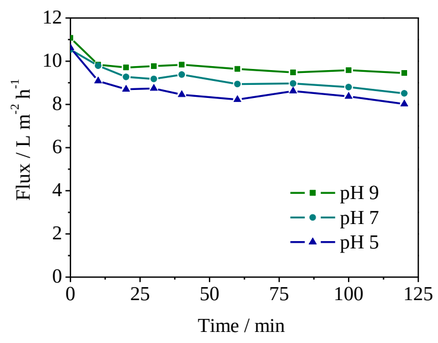


Figure 5. Flux decline at different pH (PEO 300kDa).

CONCLUSION

- The retention of ZW-1 was strongly influenced by the permeate flux with the MWCO of 300 kDa at 10 L m^{-2} h^{-1} and MWCO >600 kDa at 40 L m^{-2} h^{-1}. This influence is more pronounced at lower molecular weights.
- More flux decline is present with the increase of PEO molecular weight.
- With higher pH the flux decline is milder, while the best retention is achived at neutral pH.
- When municipal wastewater was treated, ZW-1 showed high efficiency for the removal of turbidity and COD.

ACKNOWLEDGEMENT

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