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Evaluation of nanofiltration for the treatment of industrial effluents containing anionic surfactants

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Introduction

This work addresses the removal by nanofiltration (NF) of anionic surfactants (LAS and SLES) from industrial wastewaters. The main objective is the evaluation of nanofiltration in terms of membrane characteristics, operating transmembrane pressure and feed composition for maximal surfactant removal.

Methods

The NF experiments are carried out in a Unit equipped with NF-90, NF-200 and NF-270 membranes (FilmTec Corp., USA) for model solutions covering a wide range of LAS/SLES mixtures and for a LAS/SLES based wastewater from a detergent industry. All model solutions were prepared to simulate the effluent in terms of $0.43 g.L^{-1}$ of methylene blue active substances. The applied pressure varied from 15 to 25 bar.

Results

The rejection coefficients to total organic carbon (TOC) are practically independent of pressure and are higher than 95% for all model solutions and higher than 92% for the wastewater, as shown in Table 1.

Table 1 – Apparent rejection coefficients, f_{TOC}, for the industrial wastewater and for the model solutions.

	NF 90				**NF 200**				**NF270**			
	15 bar	17.5 bar	20 bar	25 bar	15 bar	17.5 bar	20 bar	25 bar	15 bar	17.5 bar	20 bar	25 bar
	f_{TOC} (%)				f_{TOC} (%)				f_{TOC} (%)			
Industrial wastewater	98	98	98	99	93	93	94	94	92	93	93	93

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LAS Solution	97	98	98	98	97	97	98	97	97	97	97	97
SLES Solution	97	97	97	97	97	98	97	97	97	96	96	96
SLES/5LAS solution	96	97	98	98	96	96	97	97	96	97	97	97
SLES/10LAS solution	99	98	98	98	97	98	98	97	98	97	97	97
SLES/20LAS solution	98	97	97	97	97	98	98	98	98	98	97	97

The SLES solutions have the highest permeation fluxes of 20-33, 121-207 and 242-371 $kg.h^{-1}.m^{-2}$ for NF90, NF200 and NF270 membranes, respectively. The permeation fluxes for the other model solutions have intermediate values between the ones of the SLES solution and the ones of the wastewater. The fouling characteristics of the real effluent causes the declining of the permeation fluxes for the NF 200 and NF 270 membranes to values from 18 to 10 $kg.h^{-1}.m^{-2}$ (Figure 1).

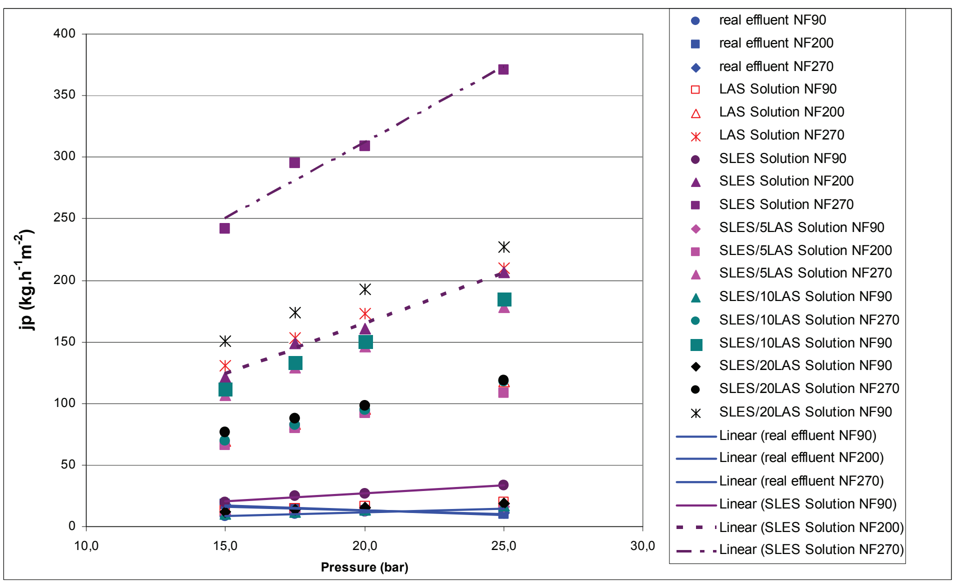

Figure 1: Permeate flux variation versus transmembrane pressure

Conclusion

In a wide range of LAS/SLES model solutions compositions, a good nanofiltration performance was achieved, combining high surfactant removal rate and high permeation fluxes.

Keywords: Nanofiltration, Anionic Surfactants, Membrane, Adsorptive Fouling