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Use of nanofiltration aromatic polyamide membranes. case study: Influence of operating conditions on the rejection of pb (II) in aqueous solutions at industrial pilot plant

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Introduction

Nanofiltration membranes have properties that combine size and electrical effects, as those present in UF membranes. NF membranes have also mechanisms of diffusion in solutions, such as the ruling transport in non porous RO (reverse osmosis) membranes [1]. The aim of our research was to analyze the potential use of nanofiltration (NF) polyamide membranes for the removal of lead ions from wastewater [2].

Nowadays, heavy metals are one of the most important pollutants. It has been shown that exposure to heavy metals are a risk for health, even at trace levels. Therefore, they are becoming a severe problem [3]. Lead is a common pollutant that can be found in various industrial effluents. Consequently, and concerning water pollution, the removal of lead cations from both industrial and municipal water is a matter of major importance[4].

Methods

The rejection tests were conducted with $Pb(NO_3)_2$. With that aim, single-salt solutions were prepared in the laboratory and treated with nanofiltration (NF) polyamide commercial membranes TFC- AFC80^{PCI} (thin film composite) in the industrial pilot plant. Experiments were taken in a pilot plant, designed and patented by the IPFM Research Group at the University of Cantabria [5]. Total recirculation was used with both permeate and concentrate returning of the feed tank to stationary conditions. The range of operating conditions tested were the following: Pressures up to 4MP; a feed cross flow in the range of 400- 1000 L/h; Temperatures of (25 – 40 ºC), and a feed concentration of 1-120 ppm.

Results

Table 1 shows the rejection values for Pb (II) as a function of concentration and pressure of operation. The results showed the high efficiency of NF process for the removal of Pb(II), with a high rejection, R, 80-94%, for a feed concentration from 1 - 120ppm. Operating conditions such as temperature, pressure, permeate flux or feed salt concentration demonstrates the influence on the rejection of Pb (II) ions.

Table 1. Rejection of Pb (II) for different concentrations of the feed and operating pressure

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Feed concentration (ppm)	Rejection (%) at different						
	10	15	20	25	30	35	40
1	94,0	94,0	94,0	94,1	94,2	93,5	94,0
20	80,4	81,1	82,2	83,0	83,3	84,0	85,0
40	78,1	80,0	80,0	81,1	82,0	83,1	85,0
60	77,4	80,0	81,1	83,0	84,1	85,1	86,1
80	83,1	84,1	85,0	86,2	86,4	87,1	87,4
120	86,0	87,1	87,1	88,0	89,1	89,2	89,3

Discussion

The low level of Pb (II) concentration at the permeate, obtained in a single stage (among 0.06 and 9 ppm respectively), implies that water with good quality could be recovered for further reuse. In order to allow the exchange of scale and its further industrial application, tests with aromatic polyamide commercial membrane TFC- AFC80^{PCI} (thin film composite) were made in the industrial pilot plant.

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