EFFECT OF IONIC STRENGTH AND pH OVER REMOVAL OF NATURAL ORGANIC MATTER CATIONIC-ANIONIC PAN MEMBRANES

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INTRODUCTION

Natural organic matter in aquatic environments can form carcinogenic organochlorine compounds when is chlorinated [1]. On the other hand, the lack of water in the southeast of Spain is the main reason for studying new alternatives of purification techniques and their optimisation. As a consequence, it will improve the use of natural waters.

The objective of this work is to study the removal of humic acids by means of an ultrafiltration system using cationic and anionic membranes of poliacrylonitrile (50 kDa MWCO) and analyze effects of pressure , conductivity an pH.

MATERIALS

♦**EQUIPMENT**: Ultrafiltration experiments were carried out in a stirred cell apparatus (Model 8200 Amicon Millipore).

♦ **MEMBRANES**: Ultrafiltration disc membranes obtained from Orelis were used. Membranes had a diameter of 63.5mm.

MEMBRANE	MATERIAL	MWCO
PAN CATIONIC	POLIACRYLONITRILE	50000
PAN ANIONIC	POLIACRYLONITRILE	50000

♦ **FEED WATER**: Three different waters were tested; Commercial humic acid (sodium salt, Aldrich). (10 mg/L). Water of Amadorio and Pedrera reservoirs

Conductivity: 1000-6000 µS/cm adjusted by addition of KCl (0.1 M).

pH: 2.5-9 adjusted by addition of sodium phosphate or H_3PO_4 buffer.

♦ **ANALYTICAL METHODS**

Dissolved Organic Carbon (DOC): Measured by Shimadzu TOC-5000 analyser.

UV absorbance: Measured by UV/VIS spectrophotometers at the 254 nm.

METHODS

♦ **FILTRATION PROTOCOL**

1º STEP: Stirred cell was initially filled with DI water and in every experiment pH, conductivity and pressure were adjusted

2º STEP: The water flux was measured as a function of time at a constant pressure (1 bar), until steady flux was achieved.

3º STEP: Stirred cell was emptied and refilled with a humic acid solution and the system was repressurized. The filtrate flow rate was measured. Permeate samples were collected periodically for subsequent concentration analysis.

4º STEP: Stirred cell was emptied and refilled with DI water at the same pH, conductivity and pressure, as the initial experiment.

Note: In all experiments the stirring speed was fixed to 200 rpm

Conductivity, pH and pressure were adjusted to following ranges, respectively: 500-6000 µS/cm, 2.7-9 and 100-400 kPa, temperature 20ºC.

RESULTS AND DISCUSSION

♦ **EFFECT OF PRESSURE**

The flux of permeate decreases when rises the ultrafiltration time.

At the end of ultrafiltration experiment and using the cationic membrane, flux reduction is 22 %, at 400 kPa of pressure. However, working at 100 kPa of pressure, the flux reduction is 9 %. In anionic membrane the flux reduction is 7.5% at 100 kPa and this value is nearly twice (16%) at 400kPa.

The DOC removal decreases with the pressure increase for cationic and anionic membranes. The DOC removal increases with the concentration factor (Vo/V) rise.

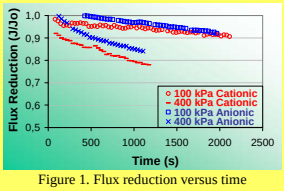

Figure 1. Flux reduction versus time

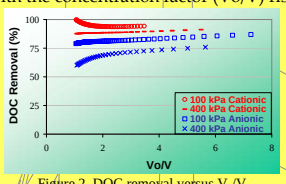

Figure 2. DOC removal versus V_0/V

♦ **CONDUTIVITY EFFECTS**

The experiments show an increase in humic acid adsorption as the ionic strength increases for both membranes, it causes an increase of flux reduction at high conductivity of the humic acid solution

For cationic membrane, flux reduction increases 8% if the conductivity increase from 1000 to 6000 µS/cm. For anionic membranes, flux reduction increases approximately 6% when the conductivity of the solution increases from 1000 to 6000 µS/cm.

At high conductivity solution, DOC removal decreases for both membranes.

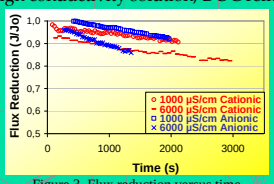

Figure 3. Flux reduction versus time

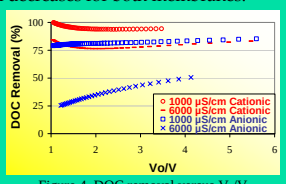

Figure 4. DOC removal versus V_0/V

♦ **pH EFFECTS**

The decrease of flux was the faster one at pH 2.5-2.7, with J/Jo=0.53 (cationic PAN membrane) and 0.58 (anionic PAN membrane) at the end of experiment, compared with J/Jo =0.9-0.8 at pH 7-9 after the same filtration time. The rapid flux decline in these ultrafiltration experiments was caused by the humic acid adsorption.

The DOC removal was slightly greater at low pH in cationic and anionic membranes

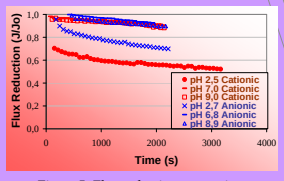

Figure 5. Flux reduction versus time

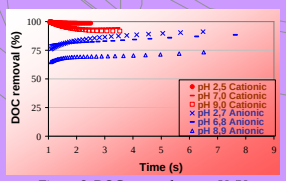

Figure 6. DOC removal versus V_0/V

♦ **REMOVAL OF ORGANIC MATTER FROM NATURAL WATER**

The decrease of flux reduction is major when natural waters of reservoirs are treated comparing with synthetic waters

Permeate flux reduction is higher in anionic membrane than in cationic membrane

DOC removal is smaller in natural waters than in synthetic waters

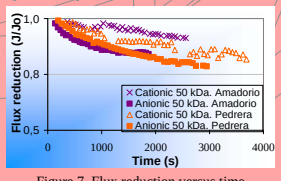

Figure 7. Flux reduction versus time

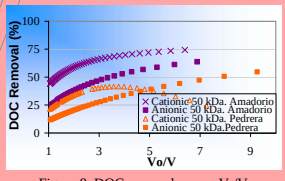

Figure 8. DOC removal versus V_0/V

♦ **CONCLUSION**

This study shows that the best remove of DOC occurs using PAN cationic membranes than PAN anionic membranes. The behaviour of fouling is similar in both membranes, although it is slightly higher using cationic PAN membranes in the ultrafiltration of synthetic waters.

High ionic strength produces a decrease of DOC removal in cationic and anionic PAN membranes. Low pH provokes an important fouling rise of membranes. Results are in accordance with those published by other authors [2][3].

In order to remove a major percentage of organic matter in natural waters it would suit to use membranes with a smaller pore size

♦ **REFERENCES**

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♦ **ACKNOWLEDGEMENT**

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