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# Influence of the operating conditions on the chemical cleaning of ultrafiltration membranes fouled with bsa solution

M.J. Luján Facundo\*, J.A. Mendoza Roca, B. Cuartas Uribe, S. Álvarez Blanco, A. Bes Piá Universidad Politécnica de Valencia. Spain

#### Introduction

Ultrafiltration (UF) is a <u>separation process</u> widely used in the industry for purifying and concentrating macromolecular  $(10^3 - 10^6 \, \text{Da})$  solutions, especially <u>protein</u> solutions.

The major problem in UF is permeate flux decline due to membrane fouling. In food industries, membrane fouling is mainly due to protein adsorption onto the membrane surface and the internal pore blockage [1]. In order to restore the membrane initial permeability it is necessary to clean the membranes so that the process could be economically feasible. There are three different types of membrane cleaning: physical, chemical and enzymatic, although chemical methods are the most often used [2].

This work is focused on the influence of the operating conditions of the chemical cleaning process (temperature of the NaOH solution, time, pH and cross flow velocities) on membrane performance. The membranes were fouled with BSA solutions.

#### Methods

A UF plant (figure 1) was used for the experiments. It was equipped with a Rayflow flat sheet module from ORELIS (France) with capacity for two membranes of 100 cm<sup>2</sup> each one, which work in series.

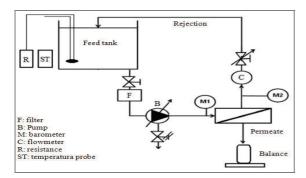


Fig 1: Flowchart of the ultrafiltration plant.

Two polymeric membranes from Koch Membrane Systems of different molecular weight cut-offs (MWCO) and materials were tested. One of them is a PES membrane of 10 kDa MWCO (membrane K131) and the other one is a PVDF membrane of 50 kDa MWCO (membrane M100).

The feed solution was a bovine serum albumin (BSA, purity>98%, Sigma-Aldrich, Germany) solution with a concentration of 1% w/w.

The fouling tests were carried out at 25 °C and transmembrane pressure of 1 bar, while two differents crossflow velocities were compared, 0.35 m/s and 2 m/s. After the fouling test, the cleaning procedure included a rinsing step performed with distilled water during 30 minutes, a chemical cleaning step and a final rinsing step until neutral pH was reached. The chemical cleaning step (with NaOH solution) was carried out at a fixed transmembrane pressure of 1 bar, while temperature and pH of the NaOH solution and crossflow velocity were varied according to an experimental design carried out with STATGRAPHICS.

#### Results

Figure 2 shows an example of the evolution of flux with time during BSA ultrafiltration for both crossflow velocities and both membranes. It can be observed that the membrane with larger pore size (M100) shows a higher flux than the membrane with smaller pore size (K131) for both cross flow velocities tested. In addition, as it was also expected, higher cross flow velocities offer higher fluxes also for both membranes.

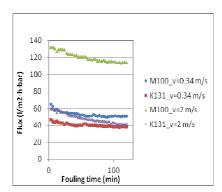


Table 1: Permeabl	ility recovery	lity depending (%)	Temper re (°C)	
Fig 2: Permeate flux during BSA ring 00 (20	(%) M100 12) 000–00	K131	time (m	in)
Table 1 shows the degree of recovery of the initial permeability for both membranes at two different temperatures of the NaOH solution and for two different durations of the cleaning step. For both membranes, the highest permeability recovery was obtained when the cleaning lasted 30 min and it was performed at 45°C. Regarding the duration of the process, there were no significant differences	93.35	78.03	45°C, min	45
			'''''	
	83.27	72.75	30°C, min	45
	97.61	87.47	45°C, min	30
	59.25	68.05	30°C, min	30

## **Discussion**

According to the results, the most important factor in the chemical cleaning step was the temperature of the NaOH solution; the higher the temperature, the greater the permeability recoveries were. The duration of the cleaning step was also studied. When the cleaning was performed at 45°C and lasted 30 min a high permeability recovery was observed. However, a further increase in the cleaning time was observed to slightly reduce the cleaning efficiency, thus indicating the interest in selecting the optimum cleaning conditions.

## Acknowledgements

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# References

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Keywords: ultrafiltration, BSA, chemical cleaning

less aggressive, 30°C and 30 minutes of the cleaning step.