

# Chloride Treatment using Hollow Fiber Supported Liquid Membranes

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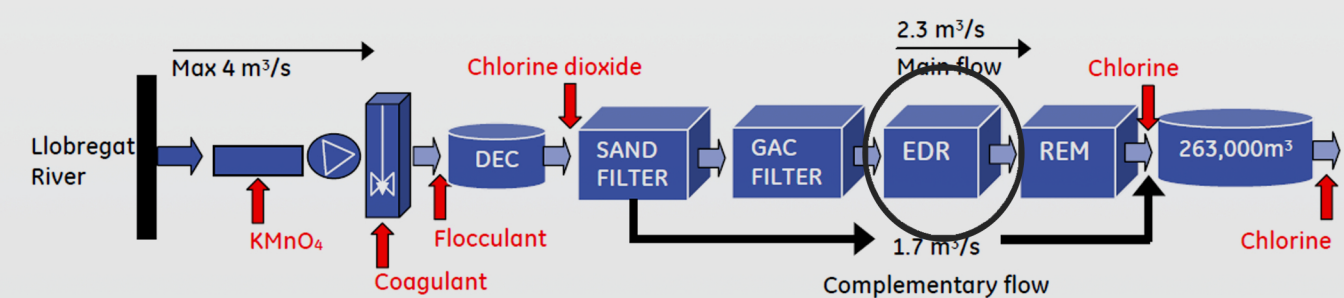
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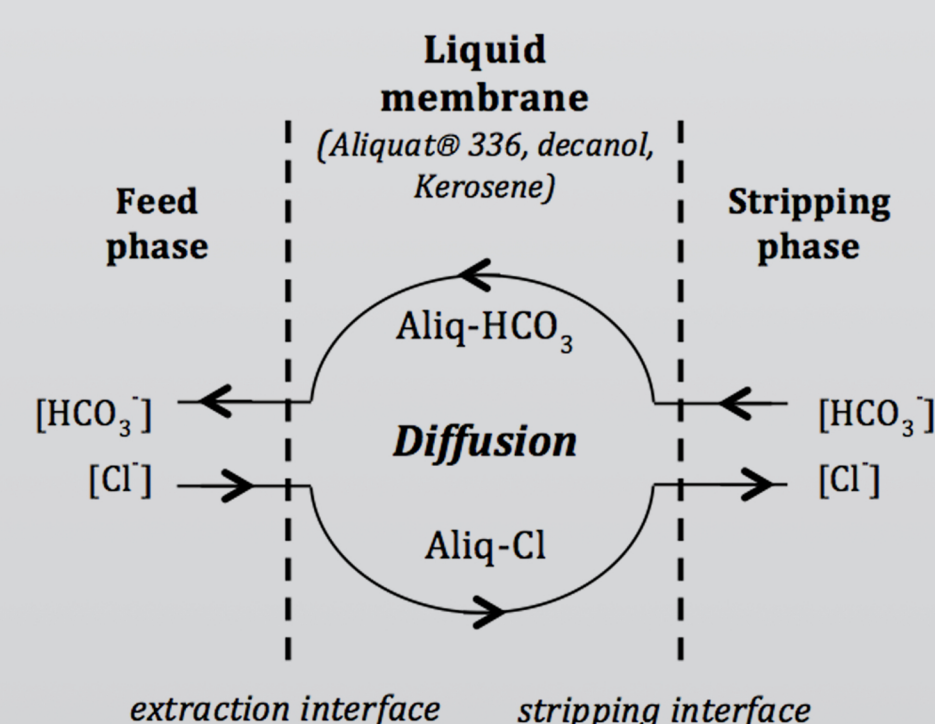
## Introduction

The project "Chloride Reduction" is about developing an alternative solution for the Abrera drinking water treatment plant to desalinate river water. The Llobregat river as one of the main sources of drinking water in Barcelona has a high salinity and does not fulfill European quality standards. Currently the Abrera water treatment plant uses electrodialysis reversal which implies the disadvantage of high electricity costs and therefore shall be replaced by the new technique.



## An alternative technique

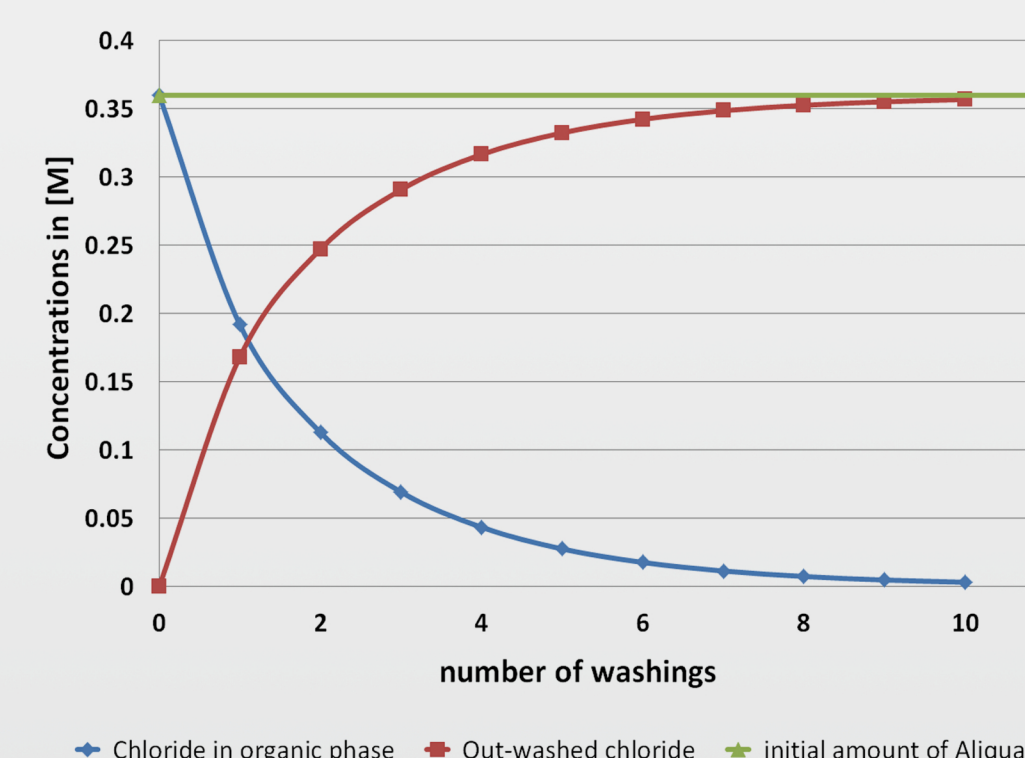
The Hollow Fiber Supported Liquid Membrane (HFSLM) technique is a promising alternative, since the required amount of electricity is less.



It is a membrane technology supplying substance transport between two separated fractions using permeable membranes filled with ionic liquids. In general the chloride ions get replaced by bicarbonate ions which desalinates the water and increases its quality.

## Hollow Fibre Supported Liquid Membrane

To examine the functionality of the technique three experiments have been carried out:

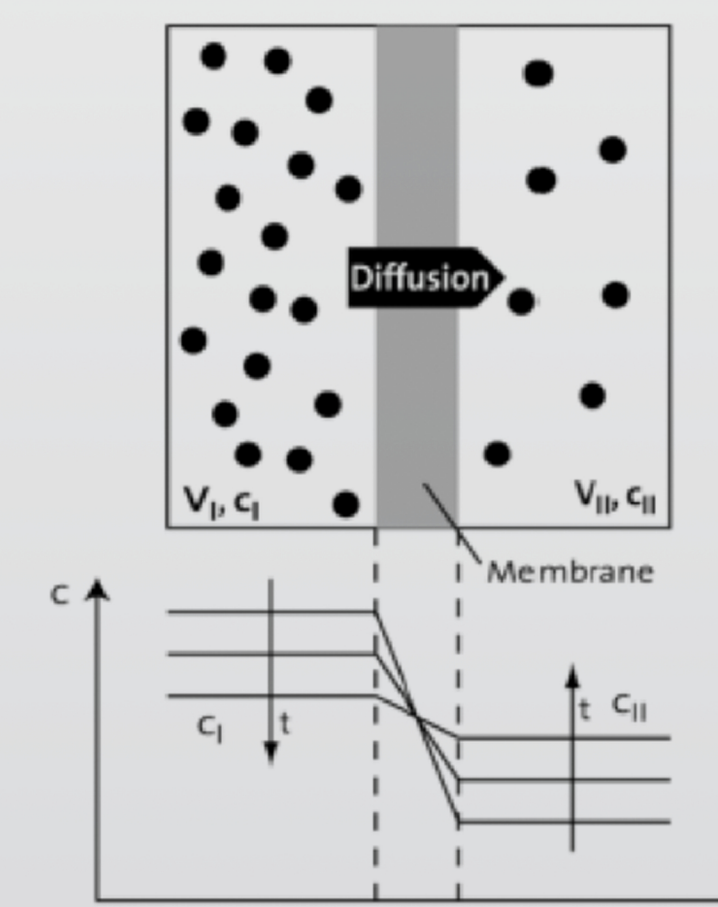


### Preparation of the phase transfer catalyst

The original solution of the used ionic liquid Aliquat 336 also contains chloride ions. These will be replaced by bicarbonate ions first in order to minimize the sources for errors. As shown in the graph, several washing procedures have to be performed to eliminate a major part of the solved

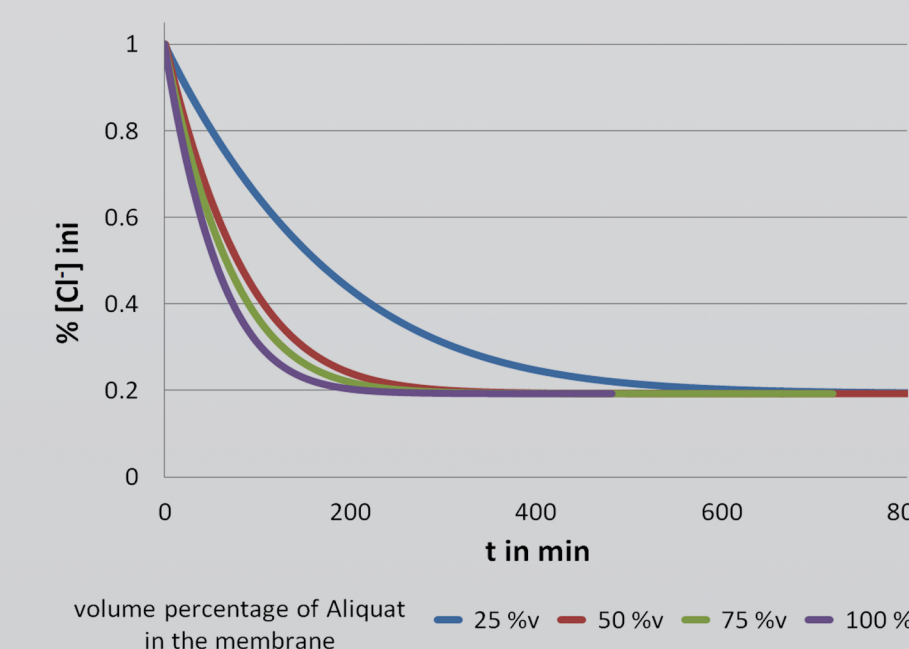
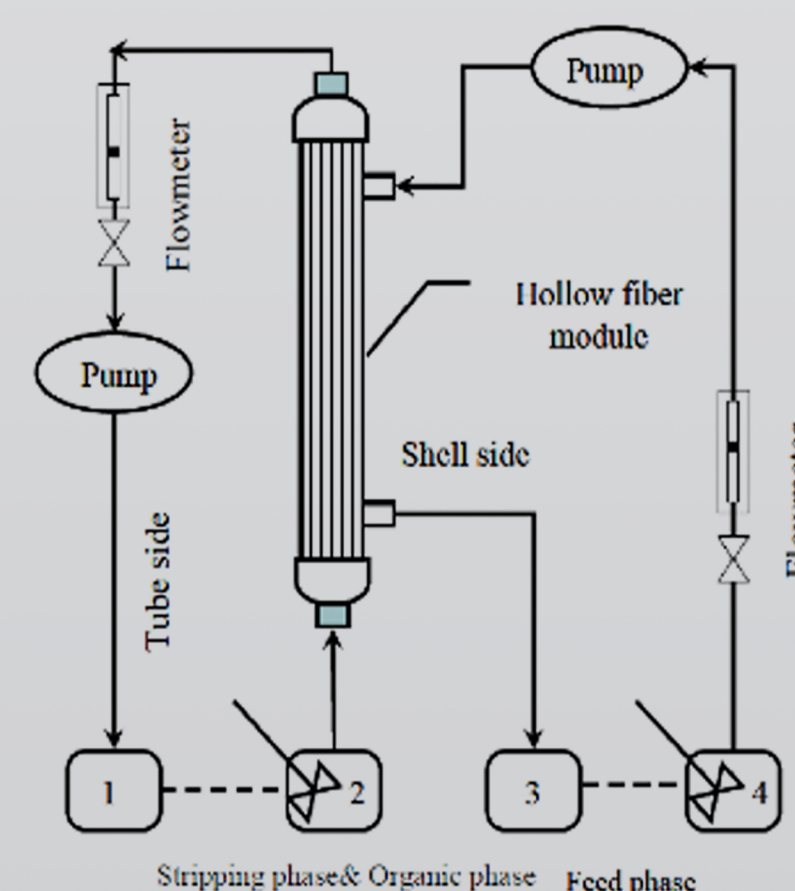
## Flat Sheet Supported Liquid Membrane (FSSLM)

The FSSLM experiment provides a first insight into the whole process that takes and delivers the data needed to prepare a mathematical model for the HFSLM technique. Basically the experiment consists of two containers that are separated by an impregnated membrane. Chloride ions diffuse with the aid of Aliquat 336 through the membrane to be exchanged with the bicarbonate ions in the other container.



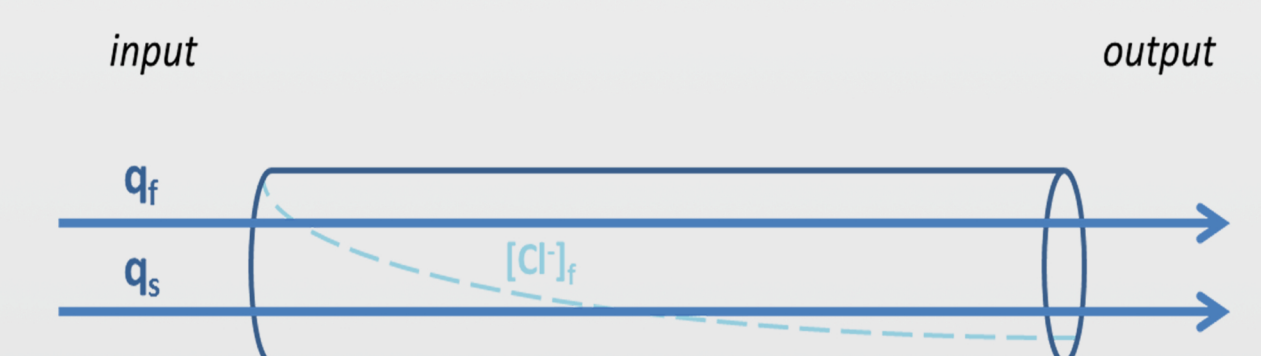
## Hollow Fiber Supported Liquid Membrane (HFSLM)

Former results were adapted to the experimental set-up shown in the figure left and the measured decrease of the chloride concentration in the stripping flow proved other efficiency of this new technique.



## Upscaling

The achieved results from the experimental part have been upscaled with the aid of MATLAB to match the values used by Abrera. All cost estimations have been conducted for the counter-current configuration, since it is the most efficient.



The overall running costs to desalinate one cubic meter are 0.2625€. Compared to the costs for electrodialysis reversal (0.23€/m³) and reverse osmosis (0.27€/m³) the HFSLM technique is competitive, especially as the technique is relatively unexplored and therefore offers a huge potential for improvement.

## Conclusions

- The HFSLM technique is a suitable method for the desalination to European Norms, but it is not capable of producing distilled water.
- In terms of costs it is highly competitive with another chloride treatment techniques.
- Unlike RO or EDR it increases the quality of water due to addition of bicarbonate anions
- Since the technique is not able to desalinate the water completely and distilled water is needed to prepare the phase transfer catalyst, it requires additional support from competitive techniques for maintenance.