Electro-membrane filtration
An Alternative Way to Fractionate Industrial Enzymes

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Electro-membrane filtration: An Alternative Way to Fractionate Industrial Enzymes

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Introduction

In the application of industrial enzymes separation, pressure driven-membrane filtration is limited to its low selectivity.

Enevoldsen and co-workers \([1,2]\) have shown that by using an electric field during crossflow ultrafiltration (EUF) of industrial enzyme solutions, an improvement in flux of 3-7 fold has been obtained.

EMF combines conventional membrane filtration with electrodialysis. In comparison with pressure-driven membrane filtration an increase in selectivity for the separation of charged components can be expected.

Methodology

- System operated in a batch-wise manner (refer to Fig.2).
- Two industrial enzymes: phospholipase (PLA) with MW 13.3KDa, PI 7.68 and lipase (LP) with MW 29.3KDa, PI 4.7 were used.
- Why PLA and LP were chosen? Pressure-driven membrane filtration is not possible to separate them due to their close MW.

Set-up & Principle

Set-up

Figure 2 Experimental set-up

Operation way and pH selection

Figure 5 Selection of operating way

Figure 6 Selection of solution pH

Experimental set-up

Figure 3 Principle of EMF

Results

Investigation of operation TMP

Figure 7 Filtration of 2gL/L LP at solution pH 7.2 and 4.7 (A) flux as function of TMP (B) transmission as function of TMP

Effect of electric field

Figure 8 Effect of electric field on the transmission of PLA. Experiments operated with initial 15gL/L feed solution, solution pH at 5 and TMP at 0.4 bar MF+M⁻MF+

Table 1 Selectivity and LP purity improvement in EMF

<table>
<thead>
<tr>
<th>Experiment</th>
<th>pH</th>
<th>Concentration (g/L)</th>
<th>LP purity (%)</th>
<th>PLA purity (%)</th>
<th>Percent of recovery (PLA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>33.6</td>
<td>22.6</td>
<td>3.08</td>
<td>3.06</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>33.6</td>
<td>22.6</td>
<td>3.08</td>
<td>3.06</td>
</tr>
</tbody>
</table>

Table 2 Selectivity and LP purity in permeate obtained at different feed concentration

<table>
<thead>
<tr>
<th>Experiment</th>
<th>pH</th>
<th>Concentration (g/L)</th>
<th>Selectivity (%)</th>
<th>LP purity (%)</th>
<th>PLA purity (%)</th>
<th>Percent of recovery (PLA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<td>33.6</td>
<td>64.2</td>
<td>27.5</td>
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<td>3.06</td>
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<tr>
<td>B</td>
<td>4</td>
<td>33.6</td>
<td>64.2</td>
<td>27.5</td>
<td>3.08</td>
<td>3.06</td>
</tr>
</tbody>
</table>

Conclusion

- By applying the electric field, PLA and LP were separated and the selectivity increased as compared to normal filtration, but the improvement was not impressive. The selectivity was also dependent on the feed concentration.
- Productivity and selectivity were not good, which seemed to be related with the solubility issue of the enzymes dependent on pH and feed conductivity. More work should be done to reduce the fouling and increase the flux.
- It seemed that LP was more easier to foul the membrane. Therefore, the other operation way which PLA is going to be removed from permeate should be tried.

Acknowledgments

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References
