**Purification of Volatile Fatty Acids from waste-derivative fermentation broth using nanofiltration**

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**Highlights**

* The retentions of VFAs increase with solution pH
* Separation factor between Ac and Bu increase with pressure and decrease with total concentration
* The best Separation is achieved at pH 8, 20 bar and total concentration of 0.1 M

**1. Introduction**

Volatile fatty acids (VFAs) are promising chemical building blocks that can be obtained by fermentation of biomass in the biorefinery concept. The present project aims to use Municipal solid waste (MSW), as raw material to produce VFAs. Previous investigations pointed out that the purification of VFAs is still a major challenge since the characteristics of the produced VFAs are similar and the fermentation broth contains many other components [1].

Nanofiltration (NF) is a pressure-driven membrane process, considered as environmentally friendly, that was already successfully used in the separation of many organic solutes like lactate and glucose [2]. Only a few reports concerning VFAs separation have been published [3], showing the necessity to improve the selectivity. The objective of this work is then to investigate the feasibility of NF for the selective recovery of VFAs from a waste-derived fermentation broth.

**2. Methods**

An experimental study is carried out using a dead-end stirred cell with a Filmtec (Dow) NF-45 membrane. The retention of the solutes is measured and the separation factor is calculated in order to characterize the separation efficiency. Synthetic solutions with various total concentration (from 0.1 mol to 0.5 mol) and pH (from 3 to 8) as well as a real fermentation broth are investigated.

**3. Results and discussion**

The results show that the individual retention of VFAs follows their molecular weight (acetate < propionate < butyrate) for all the conditions investigated (concentration and pH). The lowest VFAs retention is observed at pH 3 whereas the highest retention is obtained at pH 8, with an intermediate retention at pH 5.6 (*Fig. 1*). This phenomenon is due to the charge effects since the VFAs charge (due to the dissociation) as well as the fixed charges on the membrane surface increase with the pH. Thus, the increase of the electrostatic repulsion between the solutes and the membrane with the pH leads to the decrease of the VFAs transfer through the membrane, i.e. to the increase of their retention.

Separation factor is defined as the ratio of two solutes in the feed divided by their ratio in the permeate. At pH 8, the separation factor between Ac and Bu increase with transmembrane pressure and decrease with the total concentration of the solution (*Fig. 2*). The same trends are observed for the other pH investigated. It is also observed that a higher separation factor is achieved at higher retention.

The separation factor slowly increases as the pH increase from 3 to 5.6. However, a sharp increase is observed from a higher pH *(Fig. 3*). The highest separation factor between Ac/Bu is 2.2, and it is obtained at a total concentration of 0.1 mol, a transmembrane pressure of 20 bar and a pH of 8.



Figure 1 Individual VFAs retention versus transmembrane pressure in ternary solutions (Ac:Pr:Bu=33%:33%:33%, total concentration of 0.1 mol) at different pH



Figure 2 Separation factor of Ac/Bu versus transmembrane pressure for ternary solutions (Ac:Pr:Bu=33%:33%:33%, pH 8) at different total concentration



Figure 3 Separation factor of Ac/Bu in ternary solutions (Ac:Pr:Bu=33%:33%:33%) at different pH and total concentration

**4. Conclusions**

It is proved that NF could be used for the recovery of VFAs from a waste-derived fermentation broth. The selectivity of the recovered fractions strongly depends on the pH and total concentration of the fermentation broth, but further investigation is required to improve the efficiency of the separation.

**References**

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