LACTIC ACID RECOVERY MODELING IN FLUIDIZED BED COLUMNS

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Introduction

Lactic acid is wide use in food and pharmaceutical industry and for biomedical application. Few recovery steps, simple operational conditions, simultaneous lactate adsorption and biological solids removal make from the fluidized bed adsorption a novel process fairly attractive for biomolecules large-scale biotechnology.

Materials and Methods

Lactic acid from fermentation was early recovered in a fluidized bed column filled with Amberlite™ IRA-400. Resin weighted samples for the Pharmacia 10/20 and 20/40 columns were 5 and 15 gr., respectively. In order to evaluate the dynamic binding capacity of the resin frontal analysis were performed: Pharmacia 10/20 and pH=7-9 and Pharmacia 20/40 at pH=8. Breakthrough curves for each run were obtained.

Results and Discussion

Dynamic binding capacities values of 0.17, 0.25 and 0.27 gLA/gRes (g lactic acid per g of resin), at pH 7, 8 and 9 were respectively found when the unclarified culture broth was fed to the Pharmacia 10/20 column. The corresponding value with the Pharmacia 20/40 column at pH=8 was 0.22, similar with respect to the calculated for the Pharmacia 10/20 column at pH=8. Additional experiments should be performed in order to obtain a higher dynamic adsorption capacity value. The experimental data was also simulated with a solid liquid fluidized bed model, which was previously presented (Sosa et al., 2001). Further details of the modeling can be found elsewhere (Sosa et al., 2001). The fluidized bed length, L_f (cm), liquid solid mass transfer coefficient, $k_l a_p$ (min^{-1}), superficial velocity, u (cm min^{-1}) and fluidized bed porosity, ε, are shown in Table 1.

Table 1. Model parameters for the ion exchange adsorption in a fluidized bed of lactate from the anaerobic fermentation of *Lactobacillus casei* CRL686.

Column	L_f	$k_l a_p$	u	e
10/20 (V=9.5mL)	10	21	10	0.65
10/40 (V=95 mL)	30	13	10	0.85

Simulated parameters for the experimental breakthrough data and both columns at different pH are presented in Table 2. From the experimental dimensionless (y_{exp}) and simulated concentrations (y_i), the residue function, R (y_i-y_{exp}), was minimized.

Table2. Experimental dynamic binding capacity values and fitted parameters with the model (Sosa et al., 2001).

Column	pH	N	a (min^{-1})	R
10/20	7	2	6.5	0.06
10/20	8	2	3.5	0.10
10/20	9	2	4.5	0.04
20/40	8	3	60	0.22

The same parameter N value was found for the Pharmacia 10/20 experimental data, suggesting that this value was independent on the pH value. In these sense, low values of N indicate high degree of liquid mixing and the presence of nonhomogeneities, also pointed out in the literature (Di Felice, 1995). A well-defined solid pattern circulation was experimentally verified, and had to be upward in the middle and near the distributor, and downward near the wall. Preliminary results show a higher deactivation coefficient value at pH=7 was found, with respect to the same column and pH= 8 and 9. Hence, pH could have been correlated to the deactivation coefficient through the dynamic binding capacity values. The descending aggregates of solid movement near the wall could have been responsible for the observed channeling because solid agglomerations. The viscosity and the ascending cells of the culture broth could also have been responsible of the effects mentioned above. Otherwise, such a complex behavior was found well represented by the α parameter. However, additional experimental runs should be performed to confirm this trend. The corresponding Pharmacia 20/40 experimental data were partially fitted with the model. However, a higher N value with respect to the other column indicates that the degree of mixing could be better than those obtained in shorter columns. Further experiments are running to confirm this pattern.

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References

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