MATHEMATICAL MODELING OF ADSORPTION OF STREPTOTHRICINS IN AMBERLITE IRC-50

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Abstract -- **Adsorption kinetics and equilibrium behavior of a streptothricin compound from fermentation broth in Amberlite IRC-50 at 25 °C were studied. As a result, the adsorption kinetics curve of streptothricin and its isotherm were obtained. This compound exhibits a very slow adsorption kinetics at this temperature, while its isotherm shows a Langmuir-like adsorption pattern. Continuous adsorption experiments were carried out in columns 80×8.5 cm and 67×4.2 cm (H×D), with a linear flux ratio of 0.2 mL/(min. cm^2) at 25 °C. For the description of the process in both columns, a mathematical model was used. A good agreement with the experimental results was obtained.**

Keywords: **Modeling, adsorption, streptothricins, kinetics, equilibrium.**

I. INTRODUCTION

Mathematical modeling finds a growing application with the ever greater increase in computing power, which enhances the use of increasingly complex models. In many cases, it appears as the first choice because of the economics. Savings are obtained not only from the time reduction in getting quantitative results, but also from avoiding investment and functioning expenses.

Among all the theories used for modeling the process of adsorption in a packed column, the most common are based on the continuity equations. These involve a mass balance in both phases, which results in a set of differential equations that describe the mass exchange between the phases. Bellot (1991) considered three phases: liquid phase, stagnant liquid phase in the boundary layer, and solid phase, describing the system with a mass balance equation in the liquid phase, a continuity equation in the stagnant liquid layer around the particle, and a mass transfer rate equation. On the other hand, Golshan-Shirazi *et al.* (1989a) neglected the axial mixing and considered an infinitely fast kinetics of adsorption.

The system studied by us is constituted by a liquid phase (fermentation broth of *Streptomyces lavendulae* containing streptothricin), and a solid phase (cationic exchanger Amberlite IRC-50).

Streptothricin, one of the earliest antibiotics, was discovered in 1942 by Waksmand and Woodruff. Its delayed toxicity and nephrotoxicity prevented it from being used in medicine, but it found application in agriculture as a phytopathogenic suppressor (Vallín *et al.*, 1997). According to the number of β-lysine residues (n), streptothricins are named A, B, C, D, E, or F.

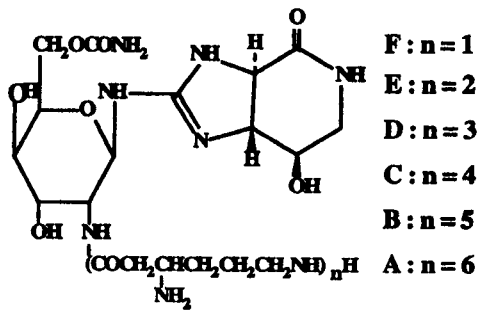

Fig. 1 Chemical structure of streptothricins.

The strain existing in our laboratory was isolated from Cuban soils by González *et al.* (1995); and afterwards taxonomically identified. As already stated by Khokhlov and Reshetov (1964), Borders (1975) and BioRad (1986), this antibiotic is adsorbed in carboxymethylcellulose or cationic exchangers like Bio-Rex 70 and Amberlite IRC-50, which have been used by Habbal (1979) for the adsorption of antibiotics, and by Greene (1978) for the adsorption of proteins.

It is not common practice for engineers to have all the necessary technological data available when developing a purification process. Regarding streptothricins, no systematic studies on the kinetics, equilibrium and adsorption dynamics were found in the current bibliography. These studies, together with the mathematical modeling of the adsorption process, are the goals of this work.

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